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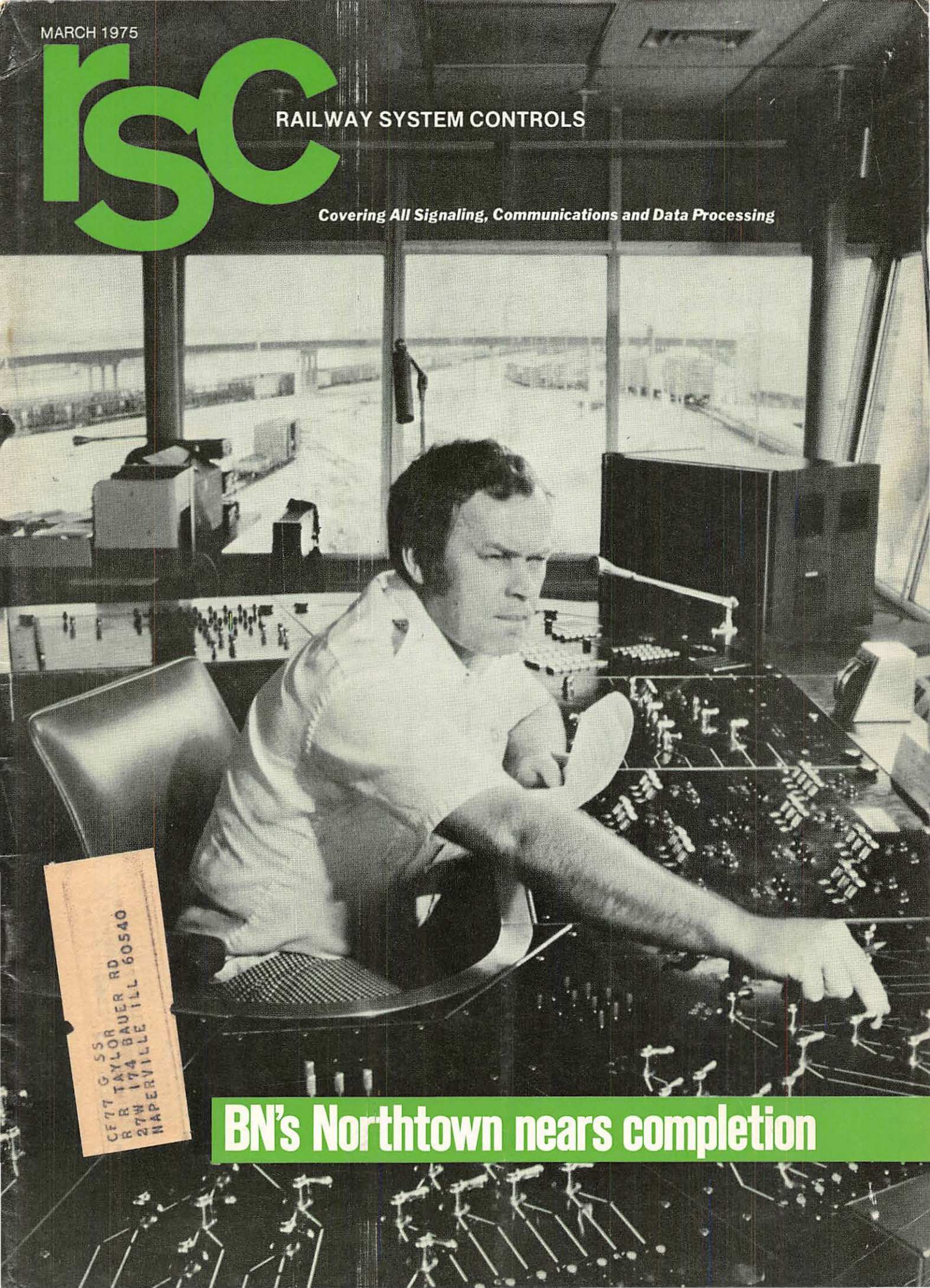

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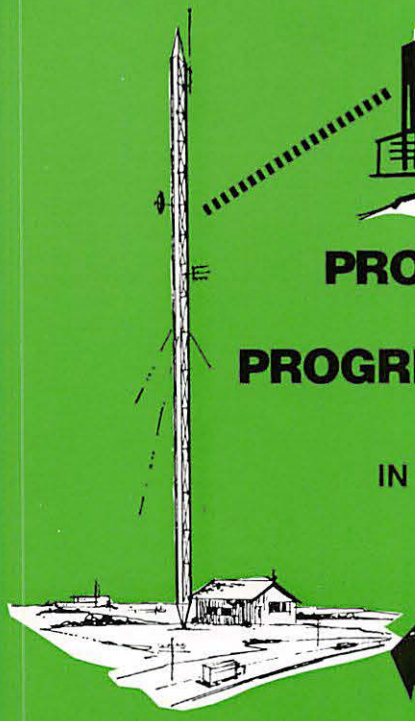
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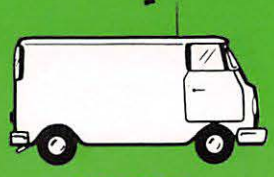
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(Formerly Railway Signaling & Communications)

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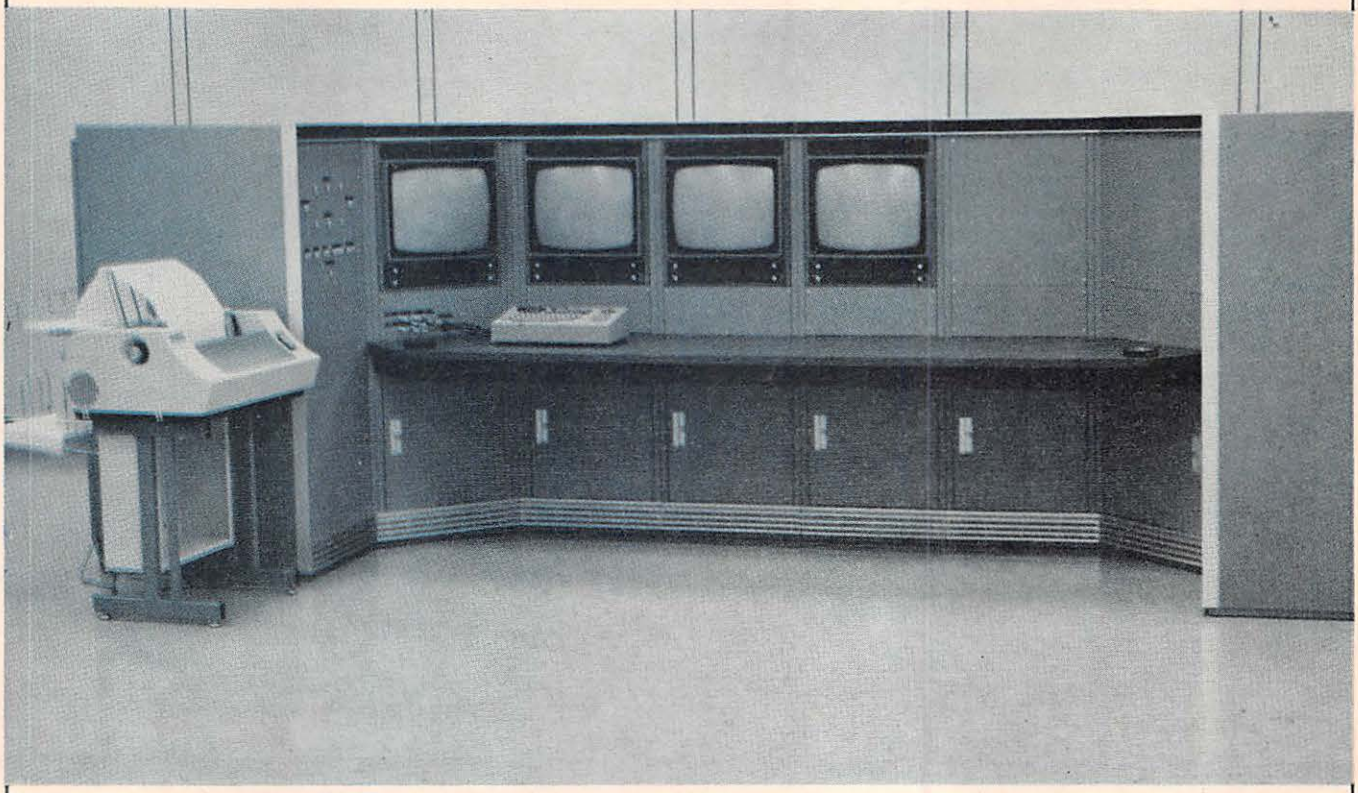

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Industry news

. . . a quick look at current events throughout the railroad industry

If the United States Railway Association's proposals for creating a 15,000-mile ConRail system in the Northeast and the Midwest is implemented, system control suppliers can look for a spurt of new business. USRA's Preliminary System Plan, released in Washington Feb. 26, identified $100 million in deferred communications and signaling maintenance which it says must be taken care of—in addition to large outlays for new C&S equipment facilities. Altogether, USRA's plan calls for investing $7.3 billion in a 14-year modernization program for ConRail, principally for new rolling stock and for roadway improvements. In addition, it's estimated that $2 billion will have to be spent on modernization of the Northeast Corridor lines which, under USRA's proposal, will be turned over to Amtrak for high-speed passenger-train service.

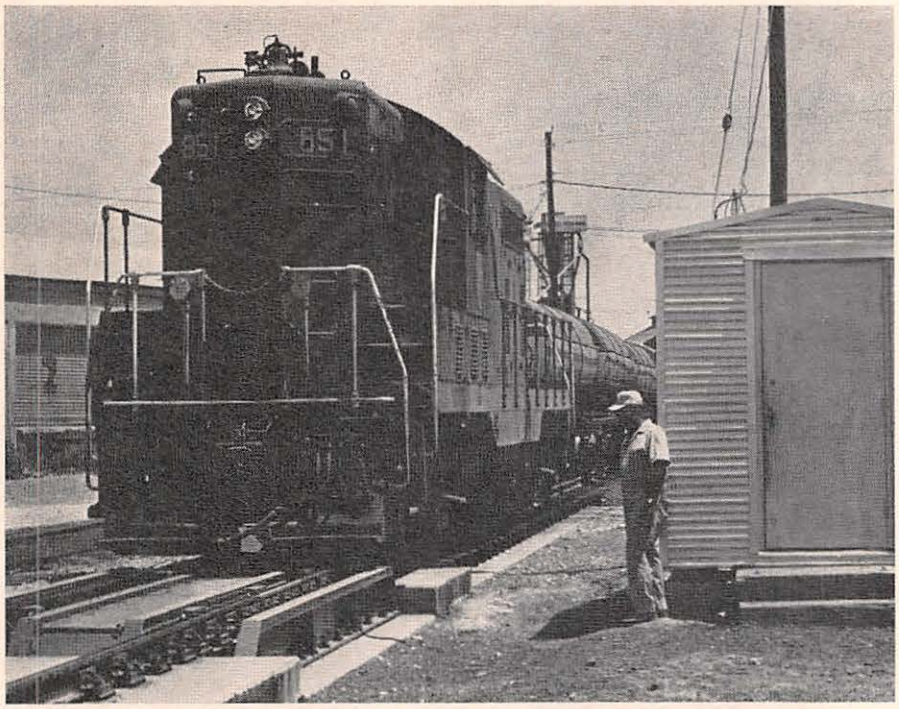
Rock Island is in deep financial water. The road's request for $100 million in emergency aid was turned down by USRA (which, under the Regional Rail Reorganization Act of 1973, is empowered to make loans to railroads to help keep them out of bankruptcy). USRA claimed that (1) the money sought by Rock Island would not be sufficient to bail out the road and (2) there was no reasonable expectation that it could be repaid. If the railroad posts a shut-down notice, as some thought likely early in March, it is considered likely that an adjoining carrier will be ordered to operate essential parts of Rock Island lines. Federal law makes provision for this—and gives the operating carrier a management fee amounting to 7% of gross revenues.

Railroads have petitioned the ICC for reconsideration of a 7% rate increase which the Commission rejected earlier this year. The carriers also plan to seek additional increases—an emergency 5.4% increase to help pay for increased labor costs that became effective Jan. 1, and a further adjustment to 8.1% when the second step of wage hikes becomes effective next Oct. 1. Between mid-1973 and mid-1974, the railroads won freight-rate increases aggregating nearly 24%. But a combination of inflation and recession has eaten away the benefits of these increases—and AAR President Stephen Ailes has warned that the railroads, in this year's first quarter, may operate in the red for the first time since 1961.

Amtrak is ready to purchase 200 additional Metroliner-type coaches (probably from Budd) and 235 new-design bi-level coaches (Pullman-Standard is reported to be the low bidder) as soon as problems involving the configuration of proposed new sleeping cars are ironed out. The new equipment will cost around $245 million.

A bright spot in an otherwise-cloudy traffic picture is coal traffic. Chessie System says that growth of coal haulage on its own lines will require a capital program that "might total $1 billion in five years' time." This is a sharp upward revision of earlier estimates, announced last summer, calling for a $300 million capital improvements program.

RSC News



A Texas Mexican train approaching an electronic coupled-in-motion scale enroute from Laredo, Tex. freight yard to Mexico. System control equipment is housed in building at right; data is automatically transmitted to the Yard Office one-quarter mile away.

Texas Mexican to install freight car data system

The Texas Mexican has recently awarded a contract for installation of a new data system designed to reduce freight car handling costs and speed up service to its customers. The new system, developed by Sands Measurement Corp. of Dallas, Tex., combines computer technology with closed circuit television so that operating data is automatically generated by the movement of trains.

According to B. F. Wright, Jr., president of the Texas Mexican, "The movement of freight cars has always required that certain information be recorded in advance. Our goal is to keep the shipments moving, by automatically recording information.

Such information includes the serial number of each car, its position in the train, gross and tare weight of the car for computing net weight of its load, and the date, time and direction of train movement. The Sands data system produces a video tape recording of information generated by a combination of television cameras and a computerized electronic scale. The scale automatically weighs each car in a moving train. The cameras and recording equipment are automatically controlled by the Sands scale computer, storing all necessary information in one composite record. The stored information can then be processed by clerical personnel at their convenience using the "instant replay" capability, at any time after the train moves on.

In awarding the contract to Sands, C. H. Darnell, Jr., vice president of operations for the Texas Mexican said, "The heart of the system is the coupled-in-motion scale which we put into service last September after a joint test by the National Bureau of Standards (NBS) and the American Railway Engineering Association (AREA)."

According to S. H. Raskin, president of Sands, "The scale was the nation's first coupled-in-motion track scale to achieve final acceptance as a result of a joint test by NBS/AREA under the new accuracy tolerances adopted in 1974." The tolerances, used by regulatory bodies as criteria for scale performance, require that no more than 30 weighing errors (out of each 100 individual car weights) exceed 0.2%. Testing of the Sands scale resulted in 17 such errors out of 100 east-bound weights and 15 errors out of 100 west-bound weights. The largest single error out of 200 car weighings was 0.55%.

Darnell further stated, "The accuracy and reliability of the scale has led us to expand the scale from a simple weighing operation to a broader data system. The computer-controlled television cameras and videotape are being added as accessories without re-engineering the existing electronic scale. Addition of the data system is the culmination of cooperation between the Texas Mexican and Sands in applying the new technology of scales and data processing to railroad operations."

Solid state radar scans freight yards

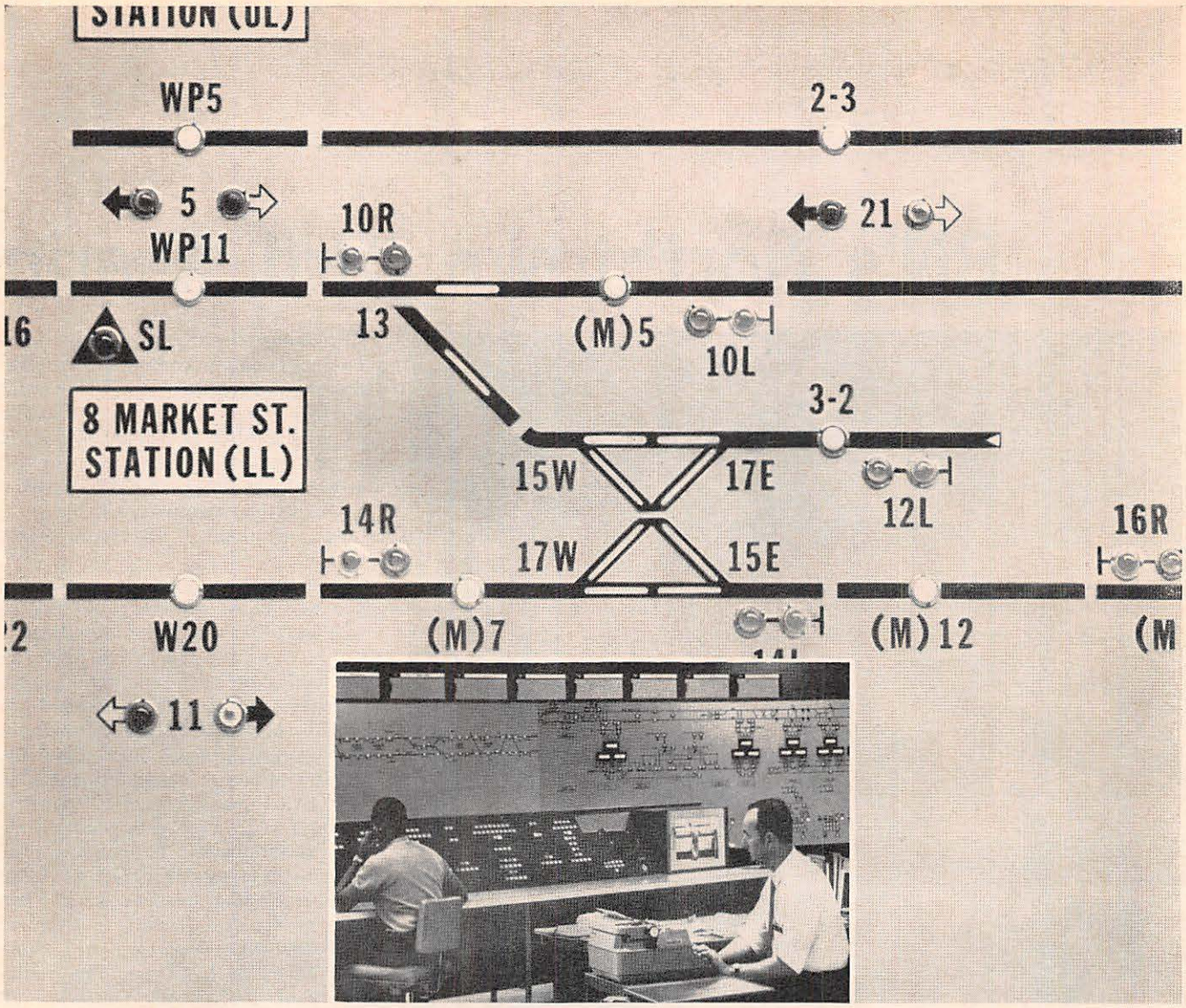
Solid state radar equipment, for measuring the speed of freight cars as they are sorted in classification yards, will soon replace vacuum tube microwave units for four major U.S. railroads. Designated the DR-40, the new radar equipment, which is said to have virtually unlimited life and requires minimal maintenance, was designed by the Union Switch & Signal Division of WABCO.

First production units of the new radar have been shipped to the Chessie System, the Chicago, Milwaukee, St. Paul & Pacific, Louisville & Nashville, and the Seaboard Coast Line, to replace older units which require frequent replacement of vacuum tubes and adjustments.

FCC issues new fee schedule

The FCC has released a new schedule of fees to become effective on March 1, 1975. Applications filed subsequent to that date should be in conformity with the new fee schedule. There are a number of changes in the schedule and all persons responsible for license applications should obtain a complete copy of the new schedule. Primary changes are as follows:

- Schedule for all VHF stations and mobile licenses is reduced from $20 to $4.
- Operational-Fixed stations using frequencies above 952 MHz are reduced to $20.
- Applications for new operator license permits, first and second class, are $4.
- Applications for renewal of operator license, first and second class, are $2.
- Applications for restricted radio-telephone permits are $4.



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PATCO's Lindenwold line races between Philadelphia and Lindenwold, N.J. carrying 38,000 passengers daily. It has an outstanding record for on-time service.

Key to the service is the WABCO Supervisory System at Camden Central Control. The track diagram panel continuously displays the location of all traffic on the line along with status of switches and signals. The WABCO control console provides control or monitoring for the following functions.

- automatic or manual control of switches and signals
- automatic or manual control of turn around patterns
- traffic normal or reverse control
- advance or retard control of automatic train dispatcher
- switch point snow melter control
- subsystem-in-use indication for digital data system sharing
- lamp test control for console and track diagram
- alarm acknowledge-pushbutton and indication
- control-reset command for request cancellation

Supervisory control of substations is provided on a separate panel.

Combine this control with voice communications throughout the system over a TRAINPHONE® System and you have some idea of why the Lindenwold line runs so well. We'd like to tell you more about it.

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BN's Northtown yard, nearing

The U-shaped supervisory control console at Northtown contains switch position controls and indicators, hump engine controls, track selection controls, and speed indicators for each retarder.

Burlington Northern's nearly completed $42-million computer-controlled Northtown Yard has been in partial operation since November 1974. The new yard located at Fridley, Minn., is about 10 miles north of Minneapolis. Early in 1975 there were 48 classification tracks (six groups) available from a planned total of 63 tracks (eight groups).

Presently, the yard is processing 1700 cars daily, with a projected increase to 2,000 cars daily within the next few months. Full operation, with all 63 classification tracks and eight groups in service, is currently scheduled for the fall of 1975. Daily throughput should eventually reach 3,000 cars daily.

This modern, computer-controlled classification yard expedites terminal operation in 12 areas contiguous to the yard. Northtown has 11 receiving yard tracks, with a total capacity of 1,349 cars. The 63 classification tracks, when all in service, will have a capacity of 2,175 cars. Nine departure yard tracks can hold up to 1500 cars. The departure yard additionally includes 20 tracks in a transfer yard with capacity for 1,026 cars. This will result in a maximum yard capacity of more than 6,000 cars, with more than 105 miles of tracks.

General Railway Signal Co., the prime control system contractor, uses two GE 4010 digital computers, selected by the BN, to govern automatic retarder control, automatic switching, and management information functions at Northtown. One computer system operates "on line" while the other computer system provides backup. Each computer has a 32K core word memory, 128K word memory per drum, and a 2M word memory per disk.

Preferred approach

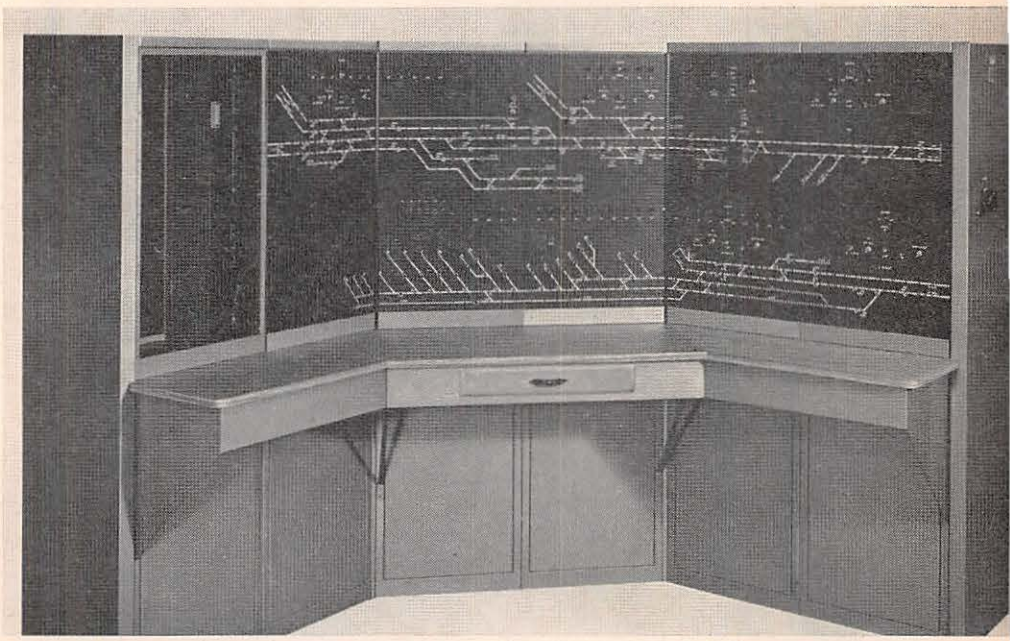
All trains scheduled for processing by Northtown are granted preferred approach routes when the NX interlocking operator elects to press the appropriate eNtrance-eXit buttons on his three-bay console. Green buttons in the track diagram represent entrance and exit points for the incoming train. An inbound train, for example a unit coal train from Bismark, N.D., can be

completion, is already working

given a yard bypass if the NX operator presses a button at the entrance to a selected route and another button at the exit to establish a "run through" route.

The advance consist for a train destined for Northtown Yard, originated at the yard that served as the train make-up center, is sent to Northtown from the BN central data processing center. This consist enables Northtown to prepare for the incoming train from preselected class track assignments logged in the computer.

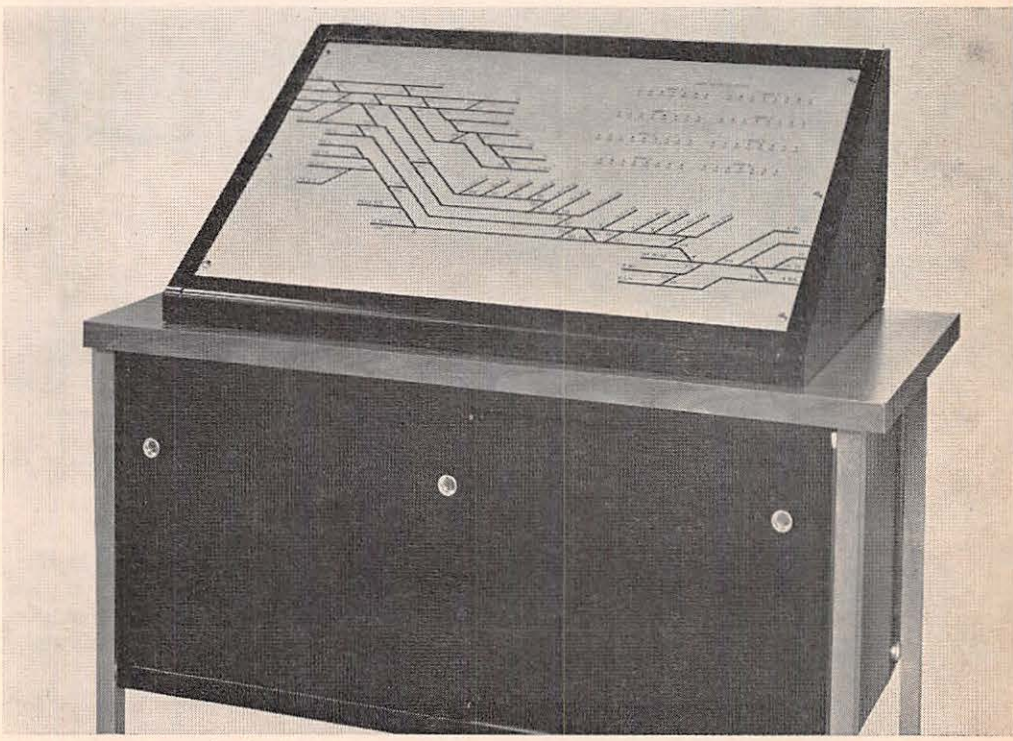
Throughout the yard, 14 video monitor terminals are discretely positioned to aid operators during the handling of the Management Information System (MIS) and Process Control (PC) functions. All but one of the 14 video monitors are 14-in. cathode ray tubes (CRT's) each displaying MIS information. One of the CRT's, a 23-in. CRT, is dedicated to PC information.



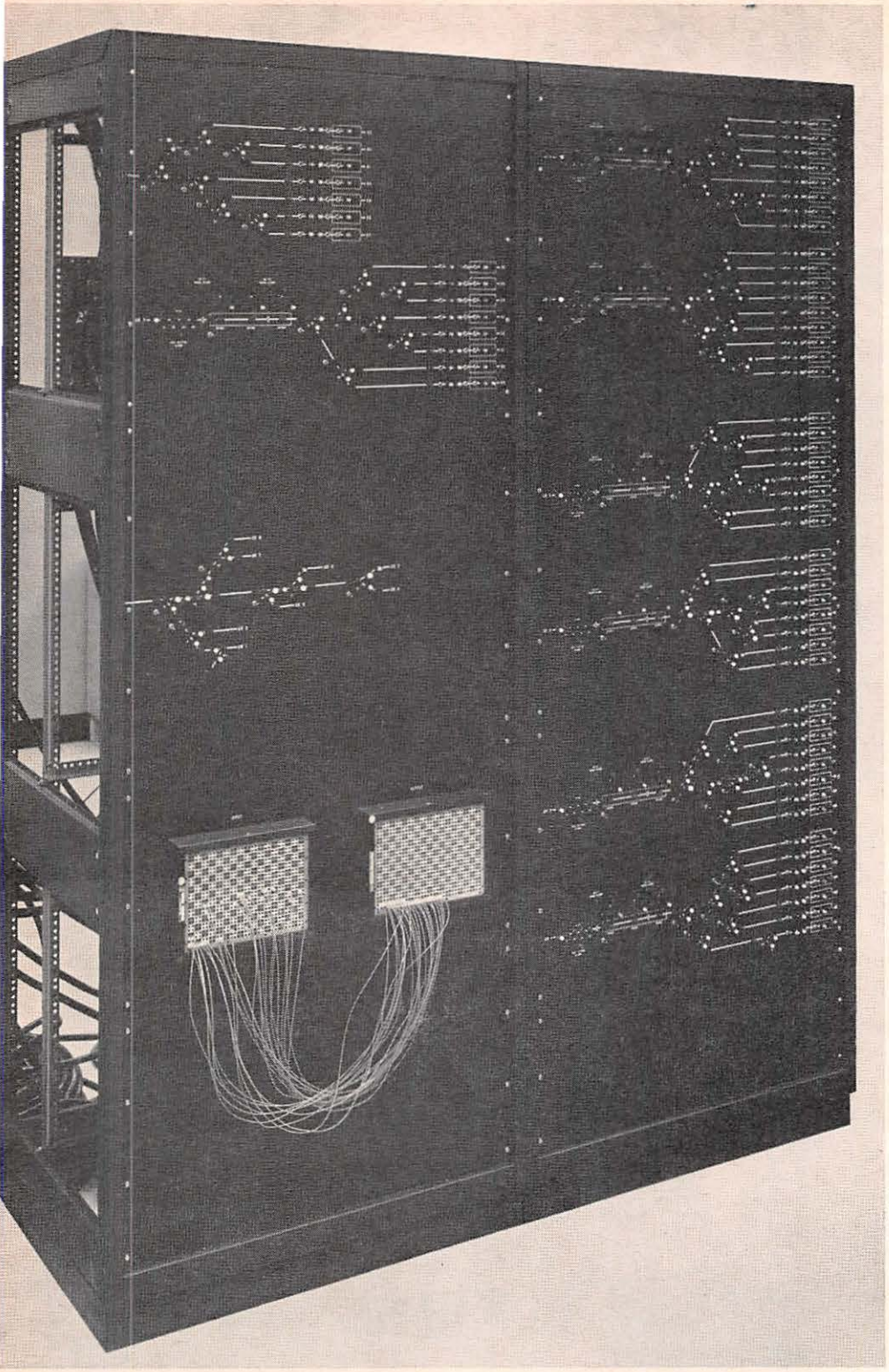
Preferred approach routes are granted to all trains scheduled for processing at Northtown. Routes are designated by the NX interlocking operator when the appropriate eNtrance-eXit buttons are pressed on the three-bay console.

Operation

The humping operation begins when the hump conductor either presses the LIST button on his console to initiate automatic switching from a prearranged switching list or presses the NO LIST button to hump the train manually by selecting the appropriate track selection buttons for the first 10 cars to be humped. A medium-speed line printer, located near the hump conductor's console, produces a hump cut list. Each car on the approach passes the automatic car identification system, and a comparison of the car's data with the stored hump list in the computer is made. Cars are shoved over the hump at a speed determined by the process computer as proper for the daily yard conditions. Four locomotives are equipped with radio controlled cab signals and digital speed control. Any two locomotives can be simultaneously operated, allowing one locomotive to operate the hump while the other advances to the second hump lead. Computer control of the locomotives is achieved by the radio link. The hump engineman places the control lever in the manual or automatic position, depending on the operational mode desired. If in the automatic mode, the hump yardmaster selects the



A switch position indicator panel located at the pullout area of the yard displays routes aligned for the departure yard.



The maintainer's test panel, or diagnostic center, displays all yard movements and routes being aligned. It monitors all real and simulated activity in the classification yard. Another section of the test panel (not shown) is used to simulate activities in the classification yard.

locomotive from his console, and as the train approaches a given point ahead of the hump crest, full automatic control begins.

Normally, single car cuts are humped, but longer cuts are permissible when the hump conductor so directs the pin puller, via a talkback speaker arrangement. The hump conductor scans a video terminal which identifies the next six cars to be humped. His U-shaped retarder console contains switch position controls and indicators, hump engine controls, track selection controls, manual retarder controls, and speed indicators for each retarder. Also, a communications panel on the same console establishes a radio communication link with operations and maintenance personnel. Cars pushed over the hump are directed to the proper class track via the computer-controlled switching system. One master and (eventually) eight group retarders, each computer directed, ensure that cuts enter class tracks at safe coupling speeds. GRS Type E-160 all-electric retarders, capable of controlling 160-ton cars, are used in the master, group, and pin puller sections. GRS Type F4 hydraulically-operated, weight-responsive, skate retarders stop and hold the classified cuts on each of the 63 class tracks. Status of pullout yard switches and retarders is presented on a small indicator console.

Master and group retarders are equipped with "Silentard", the new GRS noise abatement system, which inhibits the generation of wheel screech. Basically, the noise abatement system operates as follows: a low pressure pump system sprays a solution of emulsified oil and water onto the contacting surfaces of the retarder shoe beams and the wheels of the freight car. The emulsion serves as a friction modifier, changing the dynamic (sliding) friction characteristics of the contacting surfaces.

Control of the emulsion spray is governed by the hump computer, which sends a signal to open a valve at the retarder just prior to car entry. Similarly, another signal shuts off the spray as the car leaves the retarder. In addition, metal barriers with perforations and sound absorbent material are located on both sides and perpendicular to the retarder to help lower wheel screech to a level below the local noise ordinance requirements. (See "Retarder screech and how to combat it," RSC, Jan. '74).

When the last car of a train goes over the hump, the hump conductor terminates the humping operation by operating the EOT (End-Of-Train) pushbutton on his console. Occasionally, humping operations may be temporarily interrupted if the hump conductor chooses to press his SUSPEND button, thus allowing a locomotive to operate in the yard. Yard personnel visually check blocks of cars as they are pulled from the class tracks to verify the identity of each car in the new train consist.

A departure console in the pullout area tower provides facility for the operator to line routes from the pullout area tower to the departure tracks. Ground crews assemble a new train, based on the track clearance given. Before this operation starts, a yard computer, informed of pullback moves, generates a train consist list, which is later forwarded to the BN central data processing center.

1. Title: DERAIL

2. Definition:
A device designed to cause rolling equipment to leave the rails.

3. Symbol:
Shoe or Block

Split Point

4. Description:
Derails are either right-hand or left-hand, depending on the direction in which it is desired to cause the rolling equipment to leave the track. Looking in the direction of movement of a car or engine to be derailed, a right-hand derail is installed on the right-hand running rail and derails to the right. A left-hand derail is installed on the left-hand running rail and derails to the left.

The siding or lift derail has a shoe or block approximately 30 inches long that rests on top of the rail when in the derailing position. When it is operated, the shoe or block lifts off the rail approximately one inch and slides sideways onto a cradle. Fig. 1 shows a right-hand derail of this type in the derailing position.

Another type of derail is the split-point, which uses only one point of a switch. The point is installed in either running rail depending on the direction in which it is desired to derail the equipment. Fig. 2 shows a right-hand derail of this type in the derailing position.

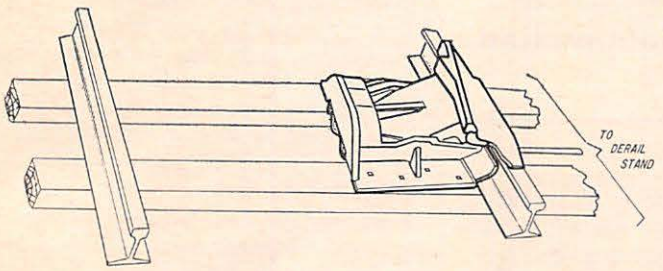


Fig. 1

5. Purpose and Application:
Derails are used wherever a track needs to be protected from unauthorized movements of cars or engines. Around shop areas they are used to protect workers from cars or engines accidentally rolling into work areas. In signal territory, derails are usually connected to a switch circuit controller.

6. General Information:
To adjust the contacts in a switch circuit controller used with a shoe or block derail, raise the shoe or block ¾ in. above rail by means of operating lever and adjust contacts to operate circuits as required. Switch circuit controller contacts on a main line split-point derail should be adjusted to operate circuits as required with the switch point open ¼ in. or more. In sidings, spur tracks and locations other than the main line where switch circuit controllers are used with split-point derails, adjustment is made with the switch point open ⅜ in. or more.

It is most important that you become familiar with your company's instructions and requirements.

7. Detailed Operation:
Derails may be operated by hand by means of a switch stand at the derail, or by a pipe connection to the main line switch stand or to a lever in a nearby control tower. Power switch machines may be used to operate derails either directly or by pipe connection.

The sliding or lift derail as shown in Fig. 1 has a shoe or block approximately 30 in. long that rests on top of the rail when in the derailing position. The lead wheel of a car or engine rolls upon the shoe or block and as it continues to roll, the wheel is forced over the rail by a flange on the shoe. At the same time the wheel on the opposite end of the axle is pulled off its running rail, causing both wheels to drop onto the crossties.

With the split-point derail, Fig. 2, the point is installed in either running rail, depending on the direction in which it is desired to derail cars or engines. When the point is open or in a derailing position, the car or engine wheel rolls through the open point until the wide gauge allows the wheels to drop onto the crossties. Sometimes two points are used the same as a regular switch. Cars or engines can then roll clear of the main running track before dropping off the rails.

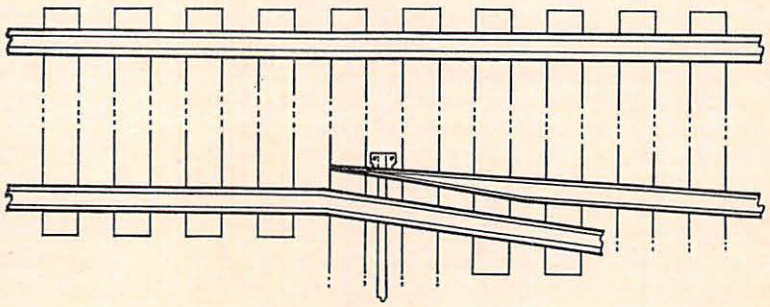


Fig. 2

Automatic identification: What, when and where

"Automatic Car Identification," "Mechanical Wagon Number Reading," "Automatic Vehicle Identification," "Train Identification," "Automatic Train Location"—the learned papers proliferate, and the list goes on and on. But basically what all it boils down to is a system for automatically indicating what, when and where a particular mode of transportation is. To the railroad industry it means knowing where a particular train is, when it passed a given point, and what cars or containers are being hauled by it.

With today's longer trains, the increasing use of containerized freight, and tomorrow's expected growth in volume, it is important that an integrated control system be backed up by up-to-date information. This information must convey what trains and what cars—defined by their car numbers—occupy which sections, between two scanning locations, at any given time.

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For identification of cars, the U.S. has adopted an optical system; it looks as though at least a part of Europe may go with a microwave system. For train identification, and in some cases automatic train control, mass transit systems in North America and Europe are using electromatic reflection and electromagnetic induction. Train destination indicator devices and stored passenger public address systems can be operated on a self-acting basis to communicate timely information to passengers before arrival or departure of a train. Other applications involve communicating information and control data to the engineer on board a train. One North American railroad is using an electro-magnetic induction system for ascertaining the location of its locomotive units.

Naturally, what may be the ideal system for one application may not be suitable for another one. But overall, most will agree that some type of automatic identification system is vital to maintain control and increase utilizaton of freight and transit equipment.

Solutions

A choice has to be made among the many possible approaches to automatic identification of transportation equipment. Automatic identification scanning methods which have been developed for consideration can be classed into the following six categories:

Radioactive systems. In such a system, radioactive elements whose position is a coded representation of the car number are arranged on the car. While this method may be operationally effective, it is undesirable because of radiation hazards and problems related to the handling of radioactive materials.

Permanent magnet systems. A number of small permanent magnets representing numbers are fastened to the cars. With the spacing between the car equipment and the reader within a fraction of an inch, such a system would work quite well. Such small spacings are, however, difficult to achieve in practical operation.

Ultrasonic systems. For this method, several ultrasonic reflectors and absorbers have to be arranged on the cars in accordance with the car code. Trouble may be caused by external noise and wind.

Optical systems. In optical systems, several surfaces with different reflection properties—such as mirrors or colored foils—are fastened to the cars in an arrangement that represents the coded number. Optical systems allow for inexpensive car units. If dirt, smoke, snow, and ice are likely to be encountered during operation, trouble may be caused by the fact that the light energy reaching the reader is too low. With proper maintenance for the car unit, or label, the optical system can produce accurate results.

Inductive systems. Electromagnetic type systems which utilize the inductive coupling between scanner and vehicle unit employ both passive and active telecommunication type modules for the vehicle unit. For car identification, the car unit is inductively supplied with electrical energy by the reader. The energy is used to power several oscillators operating at different frequencies. The frequencies corresponding to the car number code are transmitted by the car unit and are inductively transferred to the reader. In such systems, reading is highly reliable since inductive energy transfer is virtually not affected by dirt, smoke, snow, and ice. Production costs for the car unit are high since a large number of active and passive components are required. Inductive coupling devices are, however, economical for applications in mass transit and train location systems. The passive and active transponders have also been used as track side elements rather than car units. This type of application has been used for train location systems. Operation is similar to the car identification method, but in reverse.

Microwave systems. In such systems, microwave electromagnetic radiation is transferred from the reader to the car unit. The car unit is comprised of reflectors and absorbers whose special arrangement or frequency-reflecting properties represent the coded number. Another version of the car unit accepts microwave energy and uses it to drive circuitry within the car unit which in turn transmits a coded signal back to the reader. Microwave energy transfer is affected only slightly by dirt, smoke, snow, and ice. The production costs for the car unit are expected to be lower than for inductive systems in the event of large scale production.

The following articles describe a few systems and their applications which are available for automatic location or identification of trains and cars.

Positive train identification

The following paper, by N. S. Hurford, London Transport, describes the arrangements for train identification at present being developed on London Transport. It starts with an historical review of the progress of train description systems used and their development up to the present time, and shows the need to provide further information concerning the trains to meet present day requirements and future needs of an automatic railway. The paper was first presented to The Institution of Railway Signal Engineers in London and is published by permission of the Institution.

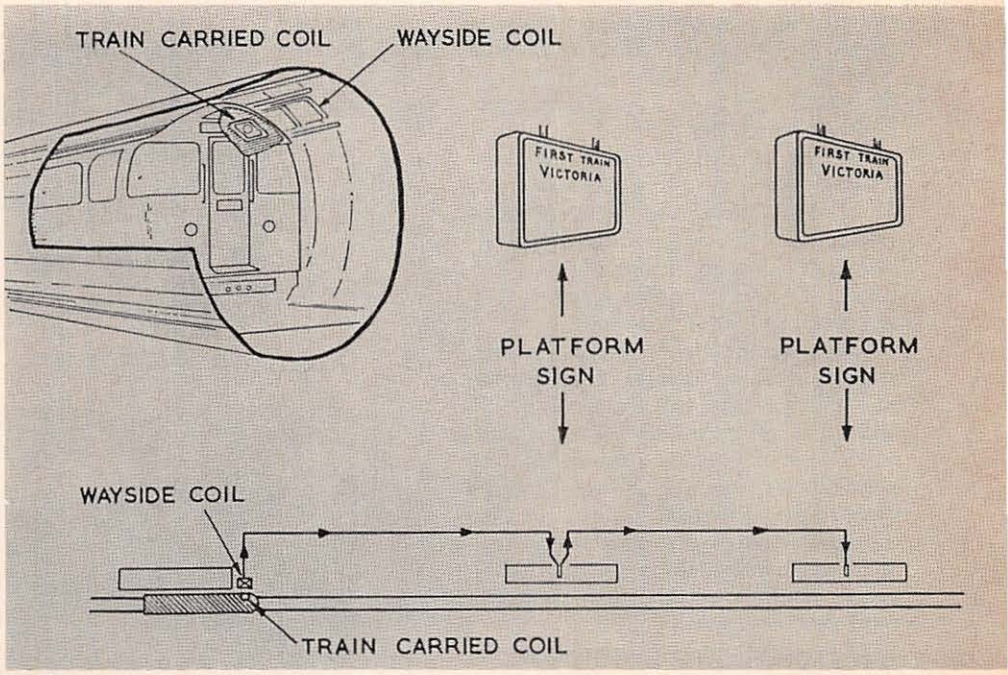


Fig. 1—Idendra train description system

The first installation of a "magazine" type train describer was on the Metropolitan District Railway in 1906, when the line was electrified and power signaling provided. The need for the installation of train describers arose from the number of trains occupying the line between signalboxes, resulting from the introduction of automatic block sections. The installation used the "drum" type storage system. The drum comprises 32 sets of four rows of spring-loaded latchable studs around its periphery, forming the storage media. Attached to a sleeve mounted on the centre spindle is a contact carrier whose contacts engage with depressed studs. There are three sets of contacts, thus making it possible to "read" the description of the first three trains in the section. Trailing behind the contact assembly is a 'plough' which resets the depressed studs. The descriptions, in a four-bit code, are decoded by a simple "combinator" device and arranged to illuminate appropriate lamps in the signalbox illuminated diagram, thus indicating to the signalman the destination of the next train or up to the next three trains. The facility to display descriptions of the next three trains approaching an interlocking enabled the signalman to adjust the service at junctions as necessary.

At the time of introduction, the train describer system was also made to operate platform signs indicating to passengers the destination of the next and sometimes the second and third trains. This ability to describe the next three trains is a useful feature on lines serving a number of destinations. The need to provide platform signs associated with the train describer system and to show the destination of more than the next train has been a significant factor in the design of such systems on London Transport.

The "drum" type system requires four line wires, plus a return wire, and is restricted to a maximum of 15 possible different destinations (by combinating the four codes) and to a maximum of 30 descriptions in a section by the size of the storage drum.

A further main installation of the "drum" type train describer system was made on what is now the Northern Line in the mid-1920s in connection with the linking of the City & South London and Hampstead tube lines and the extensions to Morden and Edgware. There were some detailed design changes, although the principles remained the same, the main change being the use of electro-pneumatic control mechanism in place of the bulky solenoids used in earlier installations.

For the train describer installation required for the Piccadilly Line extensions in 1931/32, the "ribbon storage" system was developed. In this system the required description is punched on paper tape. The advantages of the system are the capability of providing almost unlimited differing descriptions and storage capacity; it is also only a two-wire system. The tape is a permanent record and can be examined for subsequent "post mortem" inquiries. The more than ample capacity of the system was originally used for indicating "non stopping" stations as well as destinations. Its disadvantage is the need to re-paper the receiving machines weekly, a penalty in these days of high labor costs, and the need to maintain a tight specification on the paper tape. The system was used on the improvements associated with the 1930/40 New Works Programs on the Bakerloo and Central lines.

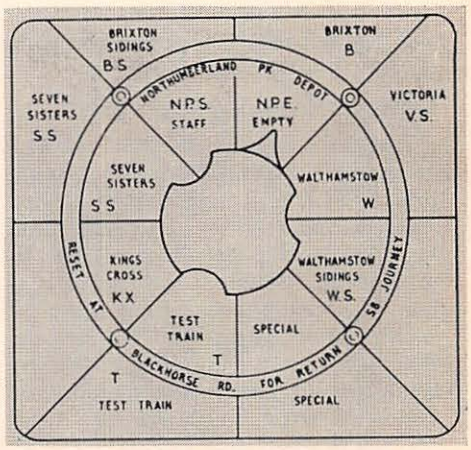


Fig. 2—Idendra switch details

For the 1935/40 New Works Program on the Metropolitan Line a train describer installation was made on a section of that line employing P.O. 3000 type relays and uniselectors. The circuit design was based upon automatic telephone exchange principles, and descriptions were transmitted in digital form over one pair of wires. The system catered for the various combinations of destinations and stations "non stopped" required by the service pattern then in operation.

The next major change in principle

was the introduction of ferrite core storage. This was used for the resignaling of the eastern section of the District Line and the Metropolitan Line works between Harrow and Amersham. The system now extends from Mansion House to Upminster, Aldgate to High Street Kensington via the north side of the Circle Line, and from Baker Street to Amersham. The form of storage reverted to a multi-element form increased to five ways to give a maximum of 31 descriptions, this being required to cope with the various "non stopping" combinations used on the Metropolitan Line. Five line wires plus a return wire are necessary with this system.

The storage elements were designed in units of 10 and a most useful feature was the provision of lamps giving an indication of codes stored to maintenance staff. It will be appreciated that prior to this time the storage elements were of a mechanical nature and thus the destinations could be visually read. A visual display feature is essential to enable staff to quickly clear faults on solid state equipment.

The control circuits external to the stores still employed P.O. 3000 type relays as time did not permit development of a solid state control system. The relays were arranged in a series of "packages" to facilitate site installation and maintenance. The system was commissioned in 1961/62.

Victoria line—identra system

The train description system provided on the Victoria Line made a fundamental change in operating principles. In all previous systems descriptions had been initiated by signalmen or later by program machines. In the identra system, the descriptions are set by the train operator in the cab. The installation represents the first form of positive train identification system provided on London Transport railways. The Identra system (meaning *"Identify Train"*) relies on mutual coupling between a fixed coil assembly mounted in the tunnel and a tuned coil on a passing train producing oscillations in the wayside equipment at a frequency dependent on the tuning of the train coil (Fig. 1). Provision is made for varying the tuning of the train coil, thus producing a number of oscillatory frequencies.

The produced frequency is transmitted via a single pair of wires to sites ahead where the particular frequency is recognized and selected and fed to storage equipment.

The Identra system as applied on the Victoria Line provides only 8 discrete descriptions, but this is sufficient for this line. The use of discrete descriptions obviates the need for the decoding equipment.

The train coil is mounted at each cab

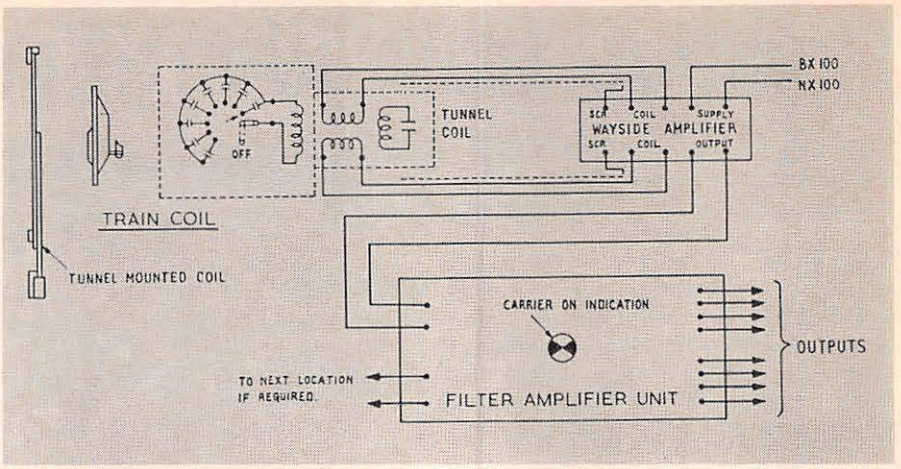


Fig. 3—Schematic of Identra system

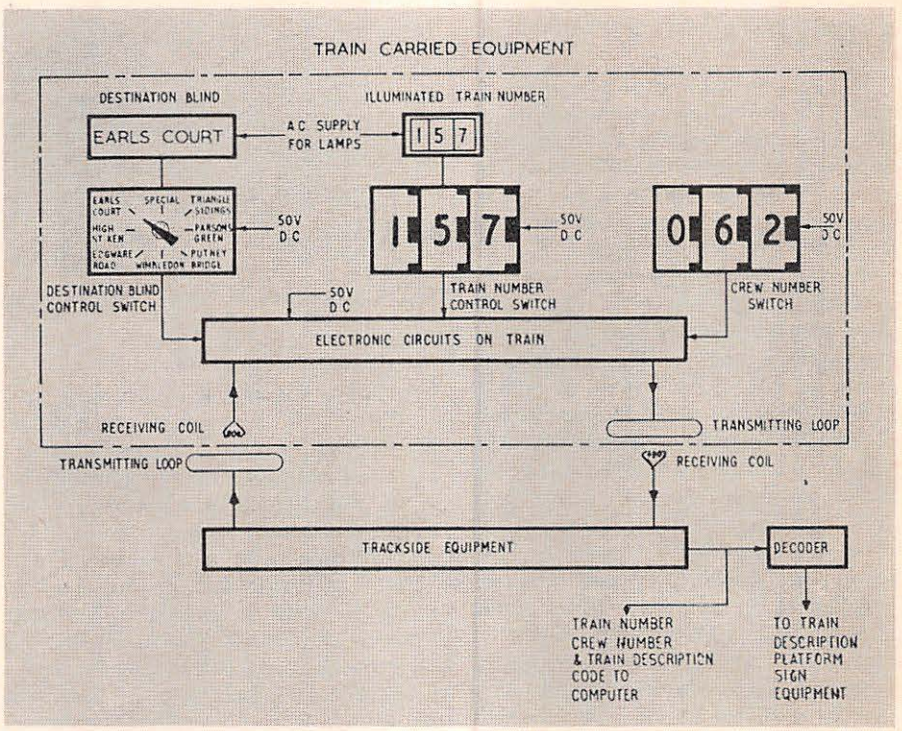


Fig. 4—Block schematic of P.T.I. system

position in the "11 o'clock" position in the direction of running. The tunnel coil assembly is mounted on the left-hand side of the tunnel in the direction of running, in a position where train and tunnel coils are approximately 6-in. apart when the coils are opposite each other.

The train coil is housed in a glass fibre case with 8 capacitors for tuning, selected by operation of the rotary switch (Fig. 2). No power supply is required by this unit. Coils housed in center cab positions are made inoperative when two four-car sets are coupled to form an eight-car service train. The 8 frequencies used are in the range 60 kHz to 98 kHz.

The tunnel assembly comprises three coils. There is fixed and a moving coil—the latter to permit on-site adjustment—and a third coil is then introduced which is pre-tuned to 53 kHz. This sets up an oscillation at this frequency in the wayside amplifier and this frequency is present at all times, except when a train coil is passing. This serves as a continuous check on the system and a check lamp is included in the relay room equipment at the station ahead (Fig. 3).

The tuned train coil interacts with the trackside coils over a distance of approximately 1 ft, one of its eight frequencies overriding the 53 kHz checking frequency. Assuming a maximum train speed of 60 mile/h, then the time of the injected signal will be in the order of 10 milliseconds.

In close proximity to the trackside coils is a wayside responder amplifier. This is a wideband transistor amplifier which is designed to transmit signals at 53 kHz with no train passing, or a

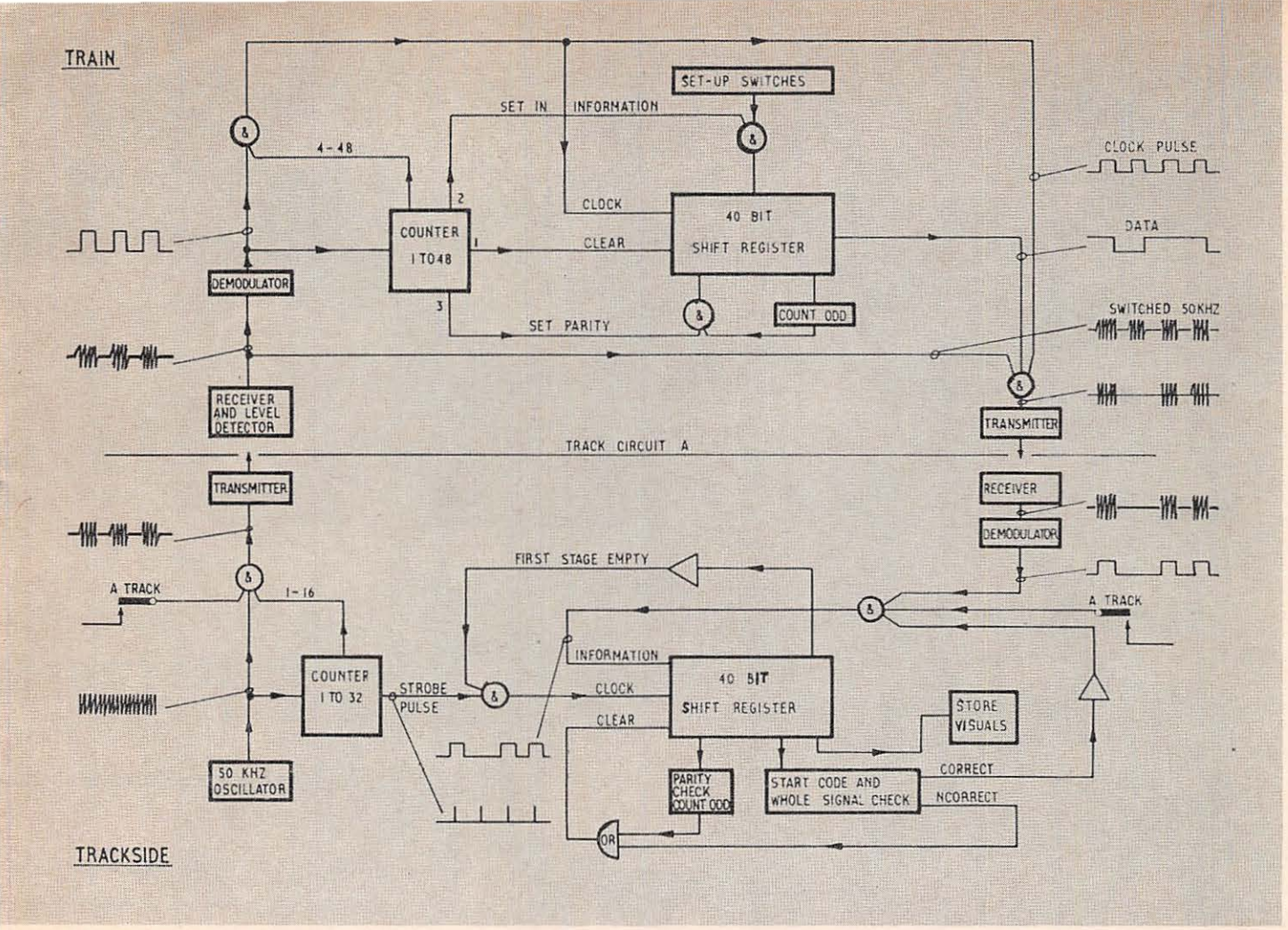


Fig. 5—Circuit principles of P.T.I. transmission

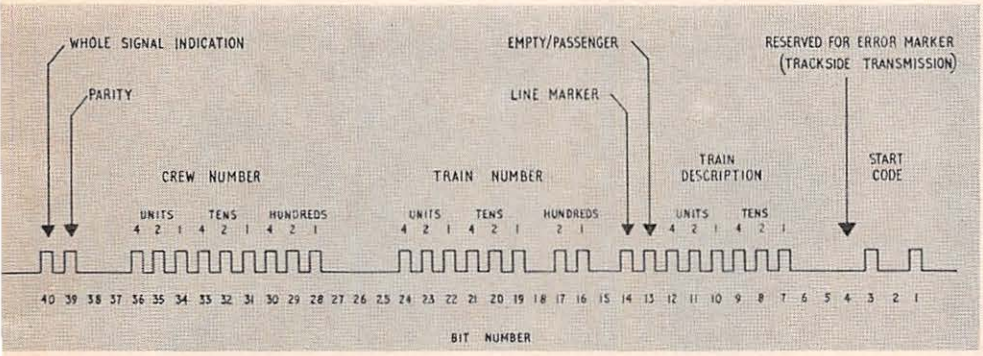

WHOLE SIGNAL INDICATION
PARITY
EMPTY/PASSENGER
LINE MARKER
RESERVED FOR ERROR MARKER
(TRACKSIDE TRANSMISSION)
CREW NUMBER
TRAIN NUMBER
TRAIN
DESCRIPTION
START
CODE
UNITS TENS HUNDREDS
4 2 1 4 2 1 4 2 1
UNITS TENS HUNDREDS
4 2 1 4 2 1 2 1
UNITS TENS
4 2 1 4 2 1
40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
BIT NUMBER

Fig. 6—Allocation of bits

higher value when a train passes, over two miles of standard 20 lb/mile telephone cable. In the relay room at the next station ahead is the filter amplifier. This unit accepts any of the nine specific frequencies which can appear from the wayside amplifier. It selects each separately and feeds a d.c. signal on one of eight lines to the storage logic.

Review of present situation

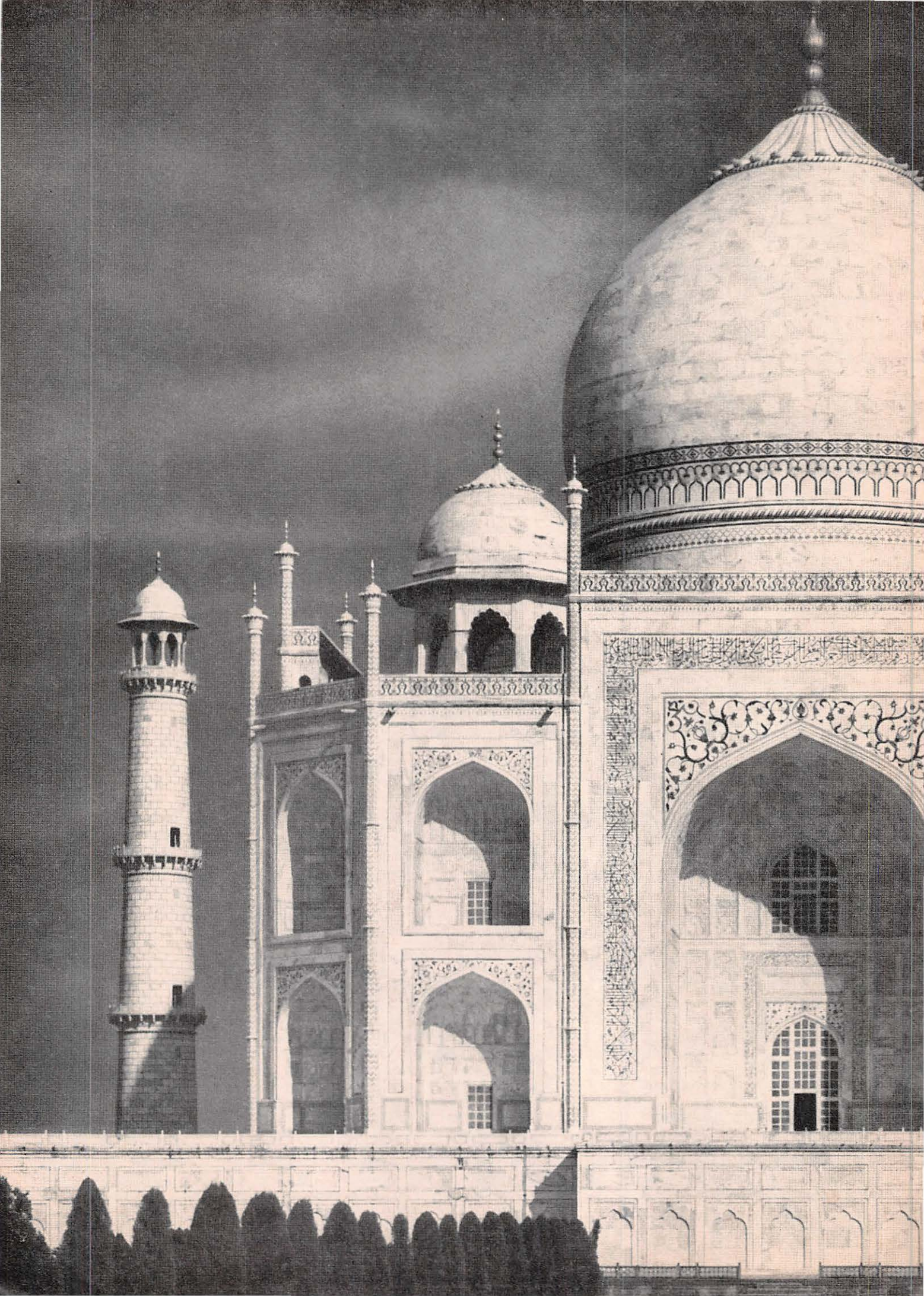
All the systems so far mentioned have been used in conjunction with the introduction of centralized control schemes with program machine control of junctions. Experience with these schemes over the past 15 years has shown that improved information in the control room is required to deal expeditiously with a level of out-of-course events now experienced. This is particularly so if there is a timetable succession of trains to one destination and these trains are not running in their correct order. Accordingly it has been decided that in addition to train destination, the train number (i.e. its running number as shown in the working timetable and displayed by figures carried on front of the train) will be transmitted. This information will enable further automation of junction working under conditions of severe service disorder.

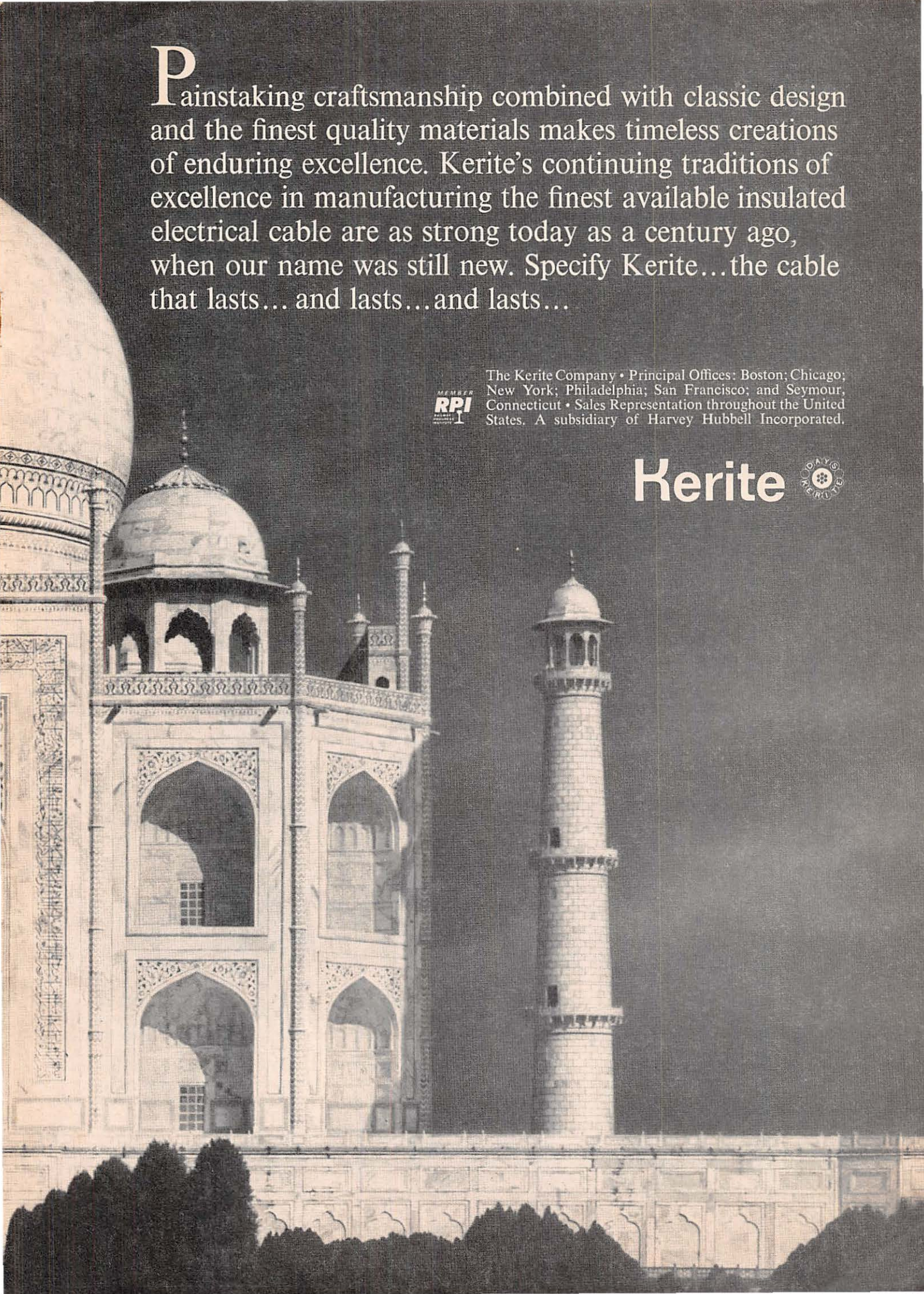
It has also been found that following service irregularities, further delays are caused by the consequent disorganization of crew duty schedules. It has therefore been decided that the crew duty roster number (this is normally a driver and guard working as a pair) should be transmitted. It is considered that this information will be of value for control by computer and to operating department supervisors in making service adjustments following service disorganization.

Prototype system

A system has therefore been developed by London Transport covering all the features outlined above. This system is known as Positive Train Identification (P.T.I.). Authority has been given for a prototype installation to obtain operating and engineering experience before a decision is made on the provision of a P.T.I. system throughout a line.

The cab equipment will be arranged so that the destination and train number information will be set by the driver





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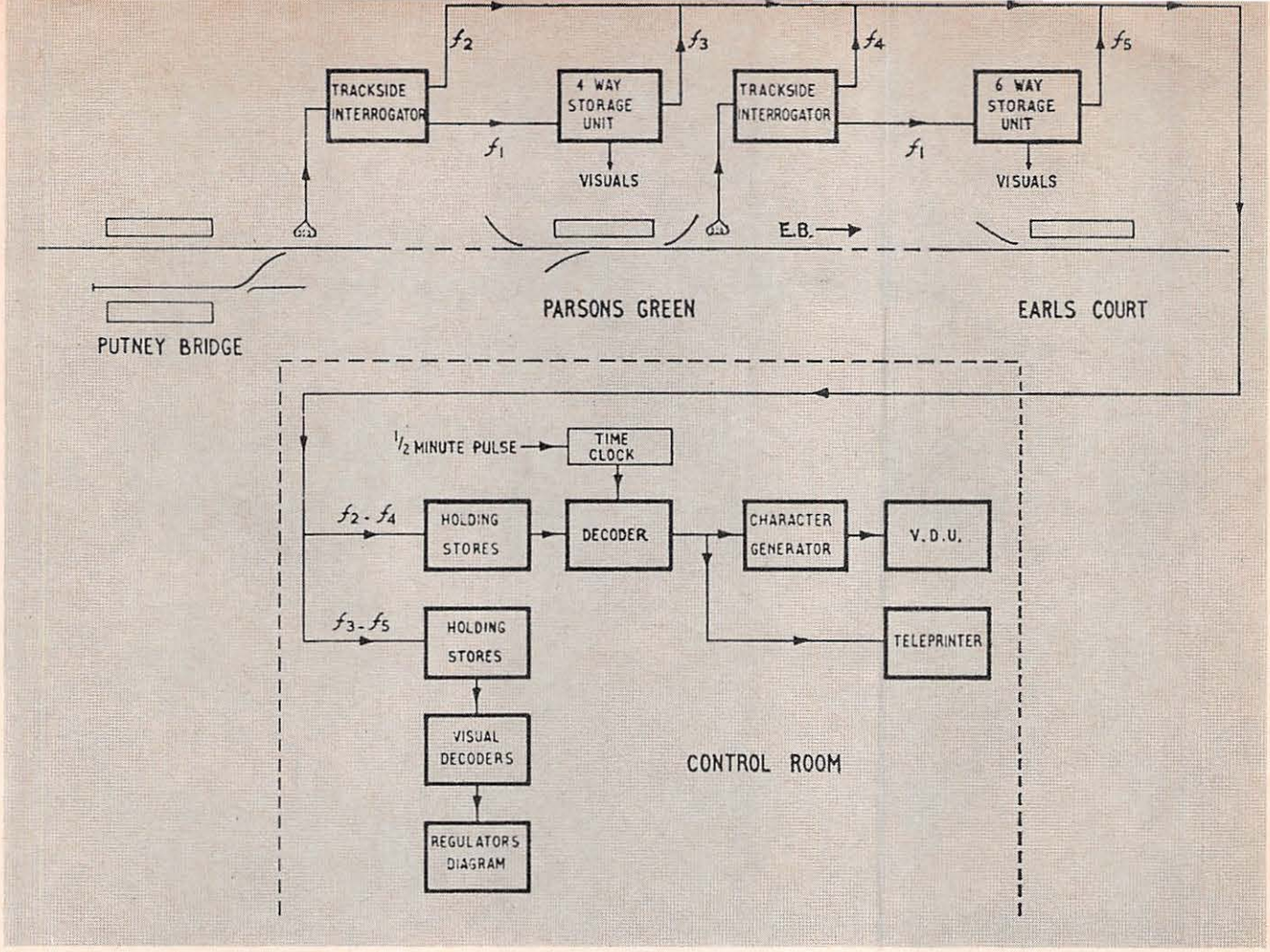


Fig. 7—Putney Line prototype installation

when the visual displays on the front of the cab are set. The crew identity number will be set initially by switches in the cab.

This information will be transmitted from train to track at appropriate points on the line.

Fig. 4 shows the overall arrangement of the system.

Prototype P.T.I. equipment

Fig. 5 is a diagram showing the circuit principle in the prototype equipment. The trackside transmission equipment comprises a 50 kHz oscillator, counter, amplifier and transmitting aerial. The 50 kHz signal is "chopped" to give 16 cycles of 50 kHz, separated by a space 16 cycles long. This signal is transmitted only when a train is in the vicinity by appropriate track circuit control. The signal received on the train aerial is demodulated and fed to a counter. This acts on a 40-bit shift register as follows. The first pulse cancels any spurious information held in the register, and ensures that it is at zero. The second pulse sets into the register the information as determined by the cab control switch positions. The third pulse sets a parity bit into the register if required, to give an even count. The remaining pulses now move the data from the register via an "and" gate to the train transmitter. The "and" gate combines the register output with the controlling clock pulse to modulate the 50 kHz signal from the receiver.

The signal is received by the track aerial and passed to the trackside equipment where it is demodulated and fed via a controlling "and" gate to a 40-bit shift register which is cycled by pulses from the counter in the trackside transmitter.

If the start code and whole signal check or parity check are not both correct, the received signal in the register is cancelled. If a second transmission from the train is received, this will then be entered. If the checks are correct, the controlling "and" gate is closed and the data is transmitted forward, as required by occupancy of an appropriate track circuit.

As at present arranged, each message has a start code "101" entered and a "whole signal" indication or end marker added at the end of the signal, which comprises 40 bits.

The received clock pulse rate in the train box is 1563 per second. The total transmission time for a 40-bit message is 28 milliseconds. Coupling between trackside and train-borne aerials occurs over a distance of at least 2 ft. The corresponding maximum train speed is therefore 48 m.p.h. for this section of the line.

Allocation of bits

Fig. 6 shows the allocation of the 40 bits in the message, as at present proposed. Six bits are allocated for train description purposes, giving 63 discrete descriptions in Octal code. An additional bit enables each description to be used for 'empty' or 'passenger' identity. The "line marker" is used to facilitate discrimination between trains on those sections where trains of more than one line operate on a common section of the railway (e.g. Metropolitan and Piccadilly Line trains between Uxbridge and Rayners Lane).

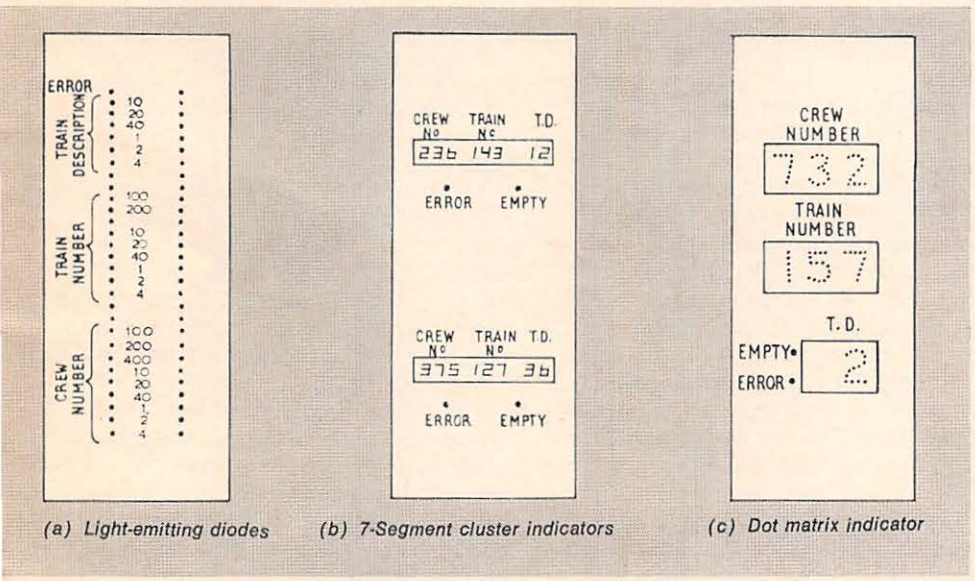
Eight bits are used for train number purposes, again using Octal code. As established in program machine usage, Nos. 8 and 9 are not used and it has been arranged that numbers between 001 and 377, omitting those with 8 or 9, can be used for train identification purposes without causing confusion where common working between lines occurs.

In the case of crew duty numbers, a similar system is proposed, omitting 8 and 9, but it has been necessary to allocate 9 bits, to cater for the number of train crews required in some lines. It will also be possible to recognize the booking-on depot of the crews by allocating the "100s" digit uniquely to a depot on a line.

WIMBLEDON LINE

CURSOR TIME	WESTBOUND LEAVING EARLS COURT	WESTBOUND LEAVING PARSONS GREEN	EASTBOUND LEAVING PUTNEY BRIDGE	EASTBOUND LEAVING PARSONS GREEN
09 12 30			D 034 121	
09 13 30	PG 073 123			
09 14 30				D 034 121
09 16 00			00 000 000	
09 17 30	W 040 220			
09 18 00				00 000 000
09 20 00			U 126 132	
09 22 00	PB E 074 371			U 126 132
09 22 30		W 040 220		
09 24 00			HS 071 223	
09 26 00				HS 071 223
09 26 30		PB E 074 371		
09 28 00			TH 016 623	
09 29 30	00 000 000			
09 30 00				TH 016 623
09 32 00			ER 063 172	
09 33 00	W 036 137			
09 34 00				ER 063 172
09 34 30		00 000 000		
09 35 00			HS 074 371	
09 37 00				HS 074 371
09 37 30	PG 070 132			
09 38 00		W 036 137	U 017 220	
09 40 00				U 017 220

Fig. 8—Printer format



(a) Light-emitting diodes (b) 7-Segment cluster indicators (c) Dot matrix indicator

Fig. 9—Methods of indicating data in stores

Putney line installation

A prototype installation is being made on the District Line between Putney Bridge and Earls Court and Fig. 7 shows the principles of the installation on the eastbound road. The purpose is to prove and evaluate the system before a decision is made on a system to be applied throughout the London Transport railways. Trials are also being made with other systems but in a manner limited to proving the train/track transmission link.

Information is read when trains leave Putney Bridge and again on leaving Parsons Green, there being interlockings at both these sites. The data is transmitted via a pair in a 20lb/mile telephone cable, using modems operating at 50 baud.

On leaving Putney Bridge information is transmitted to Parsons Green and to Earls Court control rooms. At Parsons Green the data is passed to a storage unit. The storage unit comprises a number of shift registers with controlling logic.

When appearing as the first train, the data is transmitted to Earls Court control room where it is presented as a visual display in the Regulator's diagram.

In a permanent installation the information would be used for local purposes, route setting in association with the program machines and platform sign illumination if required. For the trial installation, the existing local equipment will be retained; operated from the existing train describer equipment.

The information transmitted direct to Earls Court when a train passes a reading point, is used for monitoring and recording purposes. A permanent record is made on a teleprinter, time having been added to all trains passing each interrogator. The information, on being transmitted to Earls Court, is retained in a holding store and each half-minute is entered on the teleprinter. Fig. 8 shows the form of record made. Time to the nearest 30 seconds is registered on the left, with the train description, train number and crew number appearing in that order for each of the four reading points, which are arranged geographically on the westbound and eastbound roads.

The train describer information is converted into alphabetical characters appropriate to the destination (e.g. ER for Edgware Road). An 'E' entered after the train description indicates an empty train. A row of zeros appearing at a reading point indicates a train passing through the section which has not been equipped with P.T.I. equipment. This will occur on the Putney Bridge line as only a limited number of trains, those normally working on the Edgeware Road service, are being provided with equipment for the experiment.

In addition to the permanent record provided by the teleprinter, the information will be displayed on a visual display unit in similar form, the V.D.Us being provided as required by the Operating Department for supervisory purposes. It is for experience to show whether sufficient information can be presented on a V.D.U. to meet the immediate requirements of the Operating Department supervisors; this will depend on the number of trains and the number of reading points presented on a single V.D.U.

When the information appears as the first train in the storage provided at the local interlockings, it is transmitted to holding stores at the central control room, where it is presented as an additional display on the regulator's wall diagram. For a prototype installation, the existing train describer and train number displays will be retained. Only train description and train number information will be displayed.

The information in the holding stores

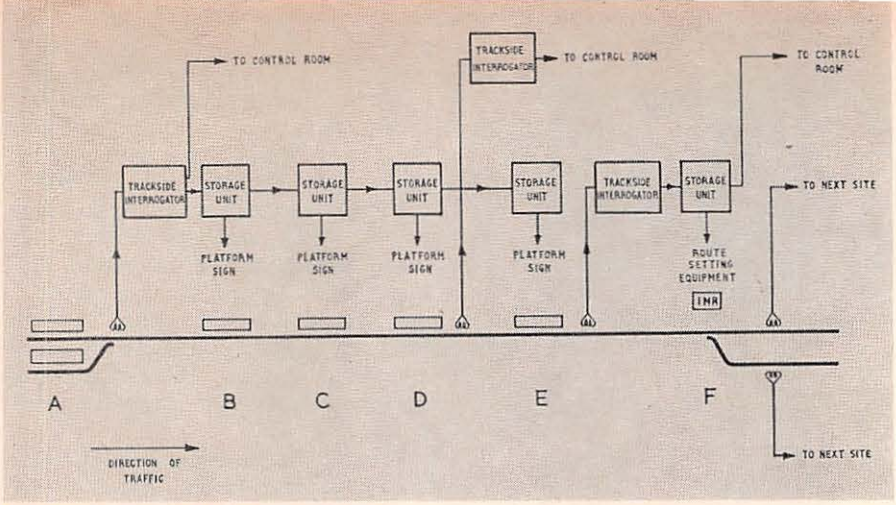


Fig. 10—Typical P.T.I. application

for the teleprinter and V.D.U. is cleared every half-minute by the clock pulse. The information in the holding stores relating to the Regulator's diagram is retained until the train actually passes the point to which the information relates. When this occurs, a cancel signal is passed to the storage unit in the local interlocking, causing the information displayed as "first train" to be cancelled and the unit automatically steps forward; before this takes place the register transmits forward a series of "zero" pulses to the holding store at the control room, which causes the register at this point to empty, thus cancelling the display in the Regulator's diagram. If a cancel circuit was arranged locally at the control room, this would mean that the P.T.I. system would become part of the signaling remote control system and it is considered that it is an advantage if the P.T.I. system can be maintained independently of the signal control system.

Future design aspects

Visuals, enabling maintenance staff to easily "read" messages stored in solid state equipment, are essential if the staff are to quickly clear and reset equipment following the occurrence of faults.

In the Victoria Line Identra equipment a single lamp only was provided to indicate if a store was occupied. This was a compromise resulting from the cost of the provision of lamps distinguishing between different descriptions. It was considered acceptable in view of the limited number of descriptions on this line.

Developments in display techniques requiring very small power have enabled other methods to be considered. Three systems were evaluated and two adopted in the trial installation namely:

a. Use of light-emitting diodes (L.E.Ds) to indicate state of each 'bit' in the store.
b. Use of seven-segment type indicators with a decoder-driver unit.
c. Use of a dot matrix type indicator with integral decoder-driver unit.

Fig. 9 shows the possible arrangement of indicators on the front panel of the storage units. Method (a) is the cheapest but the information is presented in coded form and the mounting of 58 L.E.Ds with limiting resistors presents a space problem.

Method (b) is considerably more expensive than the other methods and also requires considerable space for circuitry on the modules. It presents a straightforward, easily-read display and space is available to provide a two-way store indicator on one module end panel. The decoder is used by both indicators in a time-sharing mode.

Method (c) is clearer than (b) and requires less space for equipment on the module, but the size of the display limits its application to single-way stores.

Systems (b) and (c) are being provided in the prototype installation to gain experience. System (b) is used for the multi-way holding stores and System (c) for the single-way holding stores and trackside interrogator.

The provision of these comprehensive indicators is considered essential in a close-headway system to facilitate quick fault analysis and restoration to normal conditions following any incident causing disruption.

Provision of a P.T.I. system is an essential feature in the on-line computer control system to be installed on the Northern Line. Trackside reading points will be required after each interlocking area and any crew-changing point to update the computer.

The location of reading points will be determined to meet the needs of:

a. 'On-line' computer updating.
b. Provision of platform train indicators at intermediate stations and if more than first train information is required.
c. Automatic route setting equipment at interlockings.

Fig. 10 shows a typical arrangement. If an intermediate station, say D, was a location at which crews were changed, a reading point would be required for computer "up-date" purposes. This may also feed the storage equipment in the Interlocking Machine Room at F so that train routing information will be correct. This would be essential if the Operating Department were to reform the service following any incident and it is likely that reading points will be provided on the approach to all interlockings. In the example shown, the reading point would be at station E. Consideration would be given to combining reading points D and E.

If there were to be no platform sign installation at stations B to E the reading point at A would feed only to the Control Room for recording and computer purposes. The next reading point would be at E for train routing requirements at interlocking F.

On the Victoria Line Identra system the train operator sets his cab equipment at the last station before the train reverses, to indicate the destination of the train on its next journey after reversing. This system has the disadvantage that if it is decided to change the destination of the train after it has passed the reading point at the penultimate station the stored information cannot be changed. This is an inherent problem in the application of train identification systems at reversing locations.

The solution to this problem is likely to follow the application of on-line computers to the control of local interlockings by making use of the train number information.

The computer could use the number of the particular train to set the appropriate routes, regulate departure time and set platform indicators in accordance with the timetable in its data store or as altered as a result of decisions made by analyzing the train performance on the line.

The design of equipment for installation in the cab is a matter of compromise on existing rolling stock, space being at a premium. In new rolling stock the setting of P.T.I. information will be 'designed in' to the cab layout and integrated with the control of a motorized destination blind and internally-illuminated train number display to simplify the driver's duties. The crew number will be set by separate switches provided solely to inject this information into the P.T.I. system.

It has become apparent that a system of positively identifying trains is an essential feature of a rapid transit system of the future.

The prototype installation on the Putney line will establish the reliability of the system and enable decisions to be taken for the future, particularly regarding the presentation to the operating staff and requirements of the teleprinter record.

Train location system is now in operation on the British Columbia

The British Columbia Railway is testing a new train location system on 150 miles of main line between Vancouver and Lillooet. The new system, developed by Glenayre Electronics of North Vancouver, B.C., provides the central dispatcher with mile-by-mile location and identification of locomotives on a real-time basis. According to Glenayre, the system improves safety and can increase track usage by almost 300%.

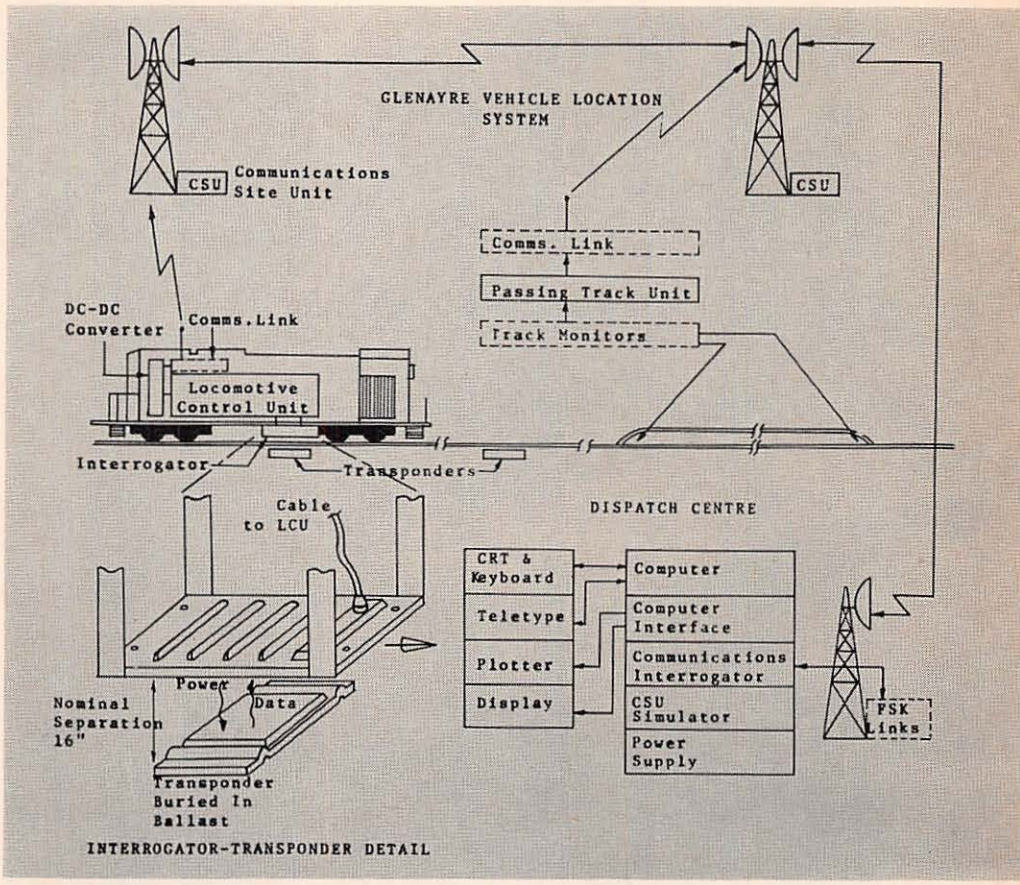
Like other North American railroads, spanning largely undeveloped country to connect widely separated cities, BC developed as a single-track line with double-track only where necessary. To ensure safety in operating two-way traffic over a single line, dispatchers issued written train orders about the times and places for proceeding and passing. Long distances between check points meant long periods of time without change of status on the Central Dispatch information board. Unexpected loadings, weather, or mechanical problems might delay one train, and the traffic in both directions would in turn be delayed.

The BC incorporated microwave radio into its communications system in the late 1950's. The network of linked stations, covering every part of the line, produced immediate improvements in operating efficiency and safety. However these gains were soon matched by increases in traffic, particularly by the ongoing construction program of new routes towards the northern boundary of the province. The BC was therefore interested in proposals for the development of a system which would identify every train over each mile of track and provide real-time control at Central Dispatch.

Design and development work was started by Glenayre in 1971. After extensive field testing, under extreme weather and operating conditions, the first installation was completed in the spring of 1974. The result is continuously updated identification and location of every train on the system-equipped region. The system is now being extended to cover the entire operating trackage of the BC.

Glenayre's system is built around newly-developed solid-state transponder and interrogator units. The system consists of four main groups:

- Locomotive Identification and Control Unit.
- Passing Track Unit (PTU).
- Communications Site Unit (as applied by BC, with existing microwave stations, Microwave Site Unit (MSU).
- Central Dispatch system



British Columbia's train location system uses a 27 MHz inductive loop for signaling the location data from the transponder to the locomotive.

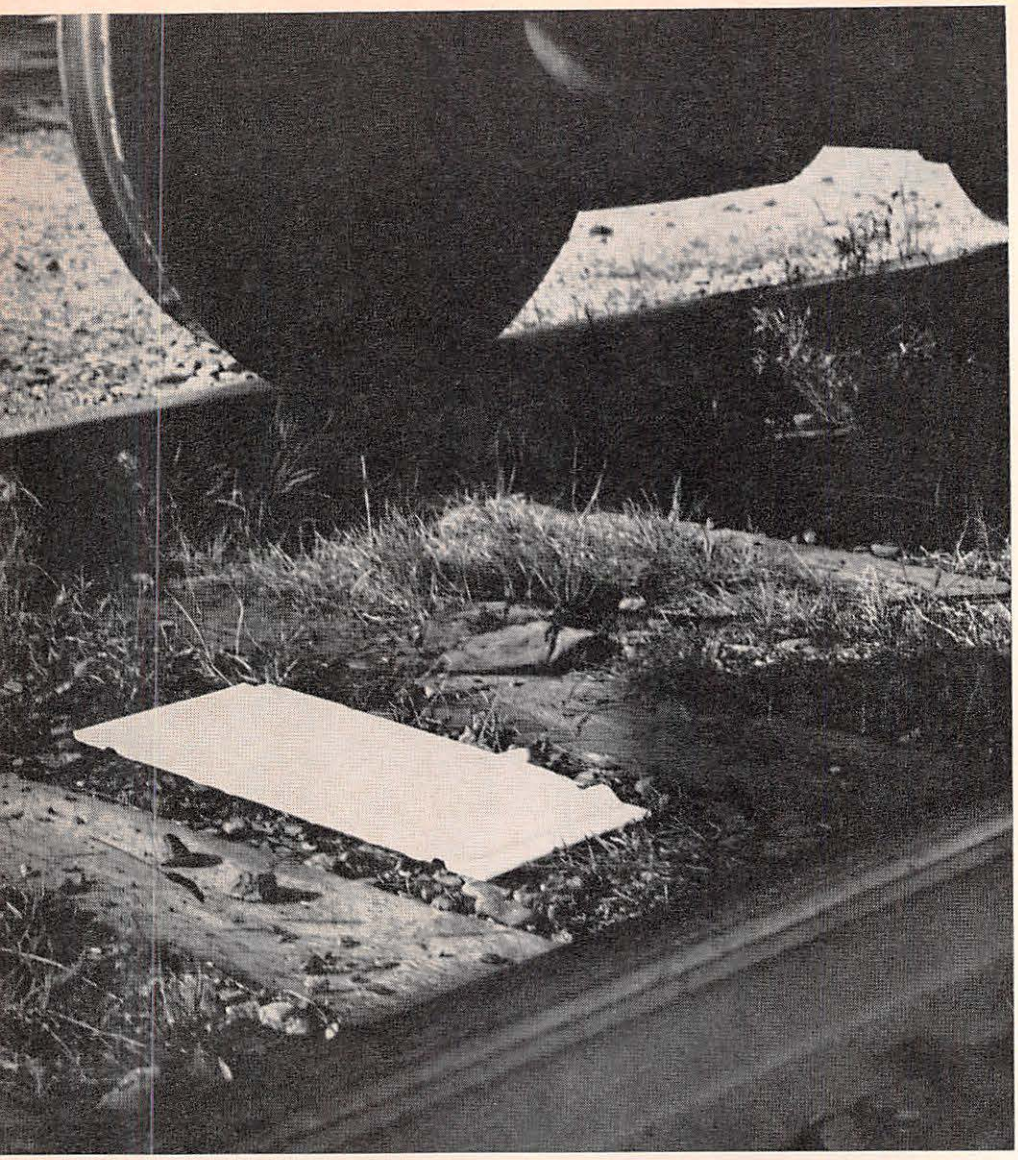
The Locomotive Identification and Control group consists of a passive transponder, buried in ballast between rail ties, and interrogator which is mounted to the underside of the locomotive, and a locomotive control unit with suitable power conversion equipment.

The transponder consists of a printed circuit board hermetically sealed inside a plastic housing. Depending on the accuracy of location required, the transponder may be positioned at any desired interval along the track. Each unit has an individual five-digit number programmed into it by means of diodes soldered in a coding matrix.

The interrogator unit is mounted under the cab of the locomotive so as to pass over the transponder within a distance of 14 to 18 in. It is a sealed printed-circuit board which radiates a continuous 200 KHz signal. During operation the transponder accepts induced power from the interrogator's signal as the locomotive passes over the transponder. The transponder rectifies the power and uses it to transmit its data signal back to the interrogator by means of a 27 MHz inductive loop. At up to 100 mph, this data signal is transmitted at full power a minimum of 15 times.

The Locomotive Control Unit (LCU) validates the transponder's data and transmits this data (via DTMF tone signaling), together with the identity number and other status information of the locomotive to the nearest microwave site for relay to Central Dispatch. The logic mounting base of the LCU is permanently wired so that any LCU, when plugged in, will transmit the identity of the particular locomotive. Data are transmitted from the LCU whenever a new transponder is encountered, when a locomotive status changes, or about five minutes after the previous transmission.

The Passing Track Unit is located at



The passive transponder, buried in ballast between rail ties, uses power from the interrogator to transmit its data signal back to the interrogator.

Central dispatch display and software is pictured with microwave interrogator unit and logic equipment.

or near a siding so as to provide status reports on the main line, the passing track, and all switches associated with the siding. This equipment is designed for mounting in an unheated weatherproof enclosure. It includes a logic mounting base with power source (usually a 12 vdc battery) and a plug-in PTU consisting of five printed circuit boards. Unit identification is contained in the base so that any PTU will assume the correct identity. The system monitors track status as indicated by relay contact closures. Following a status change, or at five minute intervals, information is relayed to the nearest Microwave Site Unit. Provision has been made for remote control linkage with Central Dispatch.

The data communications control system consists of a number of Microwave Site Units, party-line connected through the microwave stations to Central Dispatch. Data from locomotives and passing track units are decoded, validated, and stored in one of six available storage registers. When addressed by the interrogator unit at Central Dispatch, the MSU transmits the contents of its data registers.

The Central Dispatch system includes the microwave interrogator unit, computer, computer interface, display and standard computer peripheral equipment. The interrogator unit periodically scans MSU information from all sources, verifies data, and transfers it to the computer for storage and display on an indicator light display and for printout of selected messages on teletype. There is provision for checking the incoming data for transmission errors, in which case this information is printed. Specialized test equipment is also provided to allow loading of data to a remote microwave site from Central Dispatch. The test equipment also allows test data to be fed to the computer.

Close cooperation between railroad and designers permitted quick in-service adjustments to the system. Field testing confirmed the laboratory specifications for reliability under the severe operating conditions of the north. Transponder and interrogator units are unaffected by any vibration and will continue to operate through eight inches of ice or snow at temperatures between −58 and +176 degrees F.

BC has now made the train location equipment a standard part on all its locomotives and is currently extending the wayside equipment further north. Modifications to the system are being developed for automatic alerting signals and fail-safe application of the train's braking system. If by chance a restrictive signal is passed, passing switches are incorrectly set, or special restrictions become necessary from construction or accident conditions, Central Dispatch can alert the operator and take corrective action when necessary.

More applications

In volume production, transponder units will cost less than $50 each. A number of other applications have received preliminary system design, including automatic car identification in unit trains, for in-motion weighing and operating data, and similar data collecting applications for other modes of transportation. The transponder principle has also been applied to city bus transportation. BC Hydro Transit is evaluating the new system which has been added to 54 buses monitored by ten data receiving stations linked by telephone lines to their dispatch office. Toronto Transit Commission has arranged with Glenayre to test the system on the Toronto subway system. In Washington, D.C. the Federal Railroad Administration is currently considering an application by a major U.S. railroad.

50 YEARS AGO IN

Railway Signaling

Vol. 18 MARCH, 1925 No. 3

Pot-Heads Required for Parkway

With the increased use of parkway cable for signal circuits and track connections, the necessity for providing a satisfactory method of terminating this type of cable creates a problem. Especially at connections to switch machines, switch boxes and boot-leg connections to the rail, it is essential that the end of the cable be sealed to prevent moisture working back into the cable through the jute filling. The Chicago & Western Indiana, one of the pioneers in the use of parkway, protects the joint between the cable wires and the bond wires at the rail in a rise of trunking. For terminating the parkway, both at the relay box and at the rail, the Burlington has used cast-iron pot-head junction boxes filled with sealing compound. On recent installations this sealing idea has been carried to the actual joint between the cable and the wire bonded with the rail. Various methods have been worked out by other roads but the result most desirable is to form a sealed pot-head that will keep moisture from working back into the cable and cause decay of the insulation, resulting in crosses or grounds. Often times developments promising excellent savings and results are discarded on account of failure of some detail that should have been eliminated. Satisfactory pot-heads eliminate one of the faults of parkway and permit the use of this type of conductor that promises much for signal and interlocking installations.

° ° °

Railroads as Signal Manufacturers

Years ago when the signal industry was just getting started, many railroads designed and manufactured the various parts of mechanical signaling from ⅞ in. pins to spectacle castings and even in some cases the interlocking machines themselves. Many signalmen who have tried to replace one of these castings with one supposed to be similar, know full well that two of them were seldom machined alike. Like experience has more recently been demonstrated on some roads which make their own relay boxes, cable posts, etc. The crux of the situation was not that the signal engineer did not know how to prepare the plans, but rather that there was a lack of cooperation on the part of the mechanical department in becoming sufficiently interested to turn out small orders of signal equipment on an economical basis. Perhaps mechanical officers were justified in their attitude; their business is to maintain the cars and locomotives. Any outside work with which they are not acquainted is bound to cause friction and inefficiency in their foundry and machine shop organization.

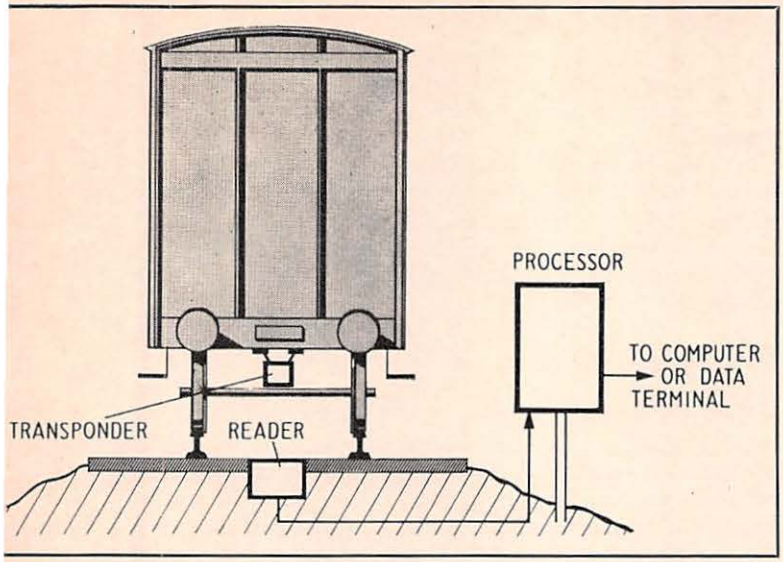
To "cap the climax" a higher officer of one road recently inquired of his signal and mechanical officers as to why the railroad could not build its own low-voltage switch machines. The signal companies have been developing switch machines for 20 years or more and during the last 10 years have spent thousands of dollars to adapt these machines to the peculiar requirements of low-voltage operation by remote control. Regardless of patent litigation, how could a railroad afford to tool-up to make a few switch machines when the tool equipment for such a set would cost far more than the saving that might be realized on hundreds of switch machines purchased from those who are in the business?

In brief, the quantity of signal apparatus required by any one road will not justify the expenditure for manufacturing facilities and the accompanying overhead charges properly accountable thereto. The quicker some roads realize this, the better will be the future operating efficiency of their signaling.

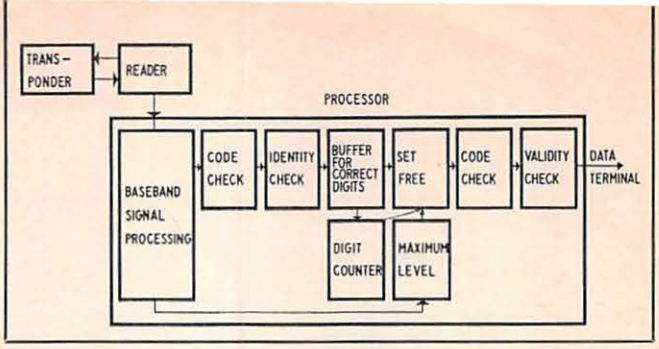
° ° °

The twelfth annual meeting of the Institution of Railway Signal Engineers was held on February 11, 1925, at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London. As in other years, the program included: the presentation of the annual report and statement of accounts, as well as of the Institution's awards for the best papers read during the 1924 session; the election of officers, council members and auditors for the ensuing year, and the inaugural address of the new president, Arthur Frank Bound. W. J. Thorrowgood, retiring president, stated in his report that the membership had increased from 523 to 563 during the past year, including the second lady associate member, Miss D. B. M. Morton, and 16 foreign members. Prizes were awarded for the best papers presented during the 1924 session as follows: First prize value 6 pounds, to W. S. Every, member of council, for his paper, "Signaling on the London Underground Railways"; Second prize, value 4 pounds, to A. C. Rose, member, for his paper, "A Survey of Indian Signaling".

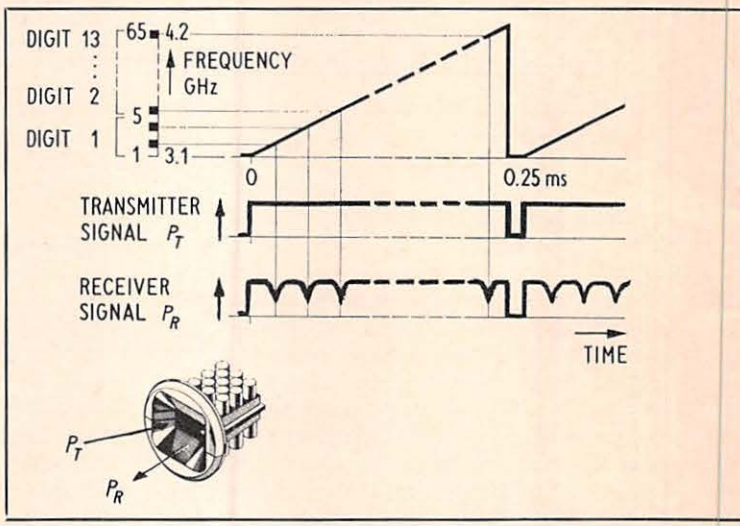
Circle 6 on Reader Service Card.



Schematic arrangement of the SICARID system with the transponder mounted under the car.



Block diagram of the car identification system.



The timing chart illustrates the operating principle of the microwave system and the use of the two-out-of-five code for generating each of 13 digits.

Microwave used for car identification

The Railway Signaling Systems Division of Siemens AG at Braunschwieg, Germany, has developed a microwave technique for automatic car identification which is being actively considered for application on East and West European railroads.

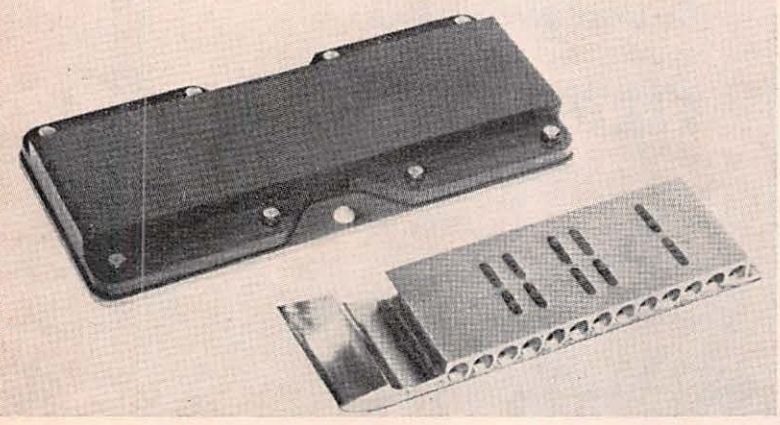
The Siemens car identification (SICARID) system consists of an interrogator mounted trackside or between the rails, a trackside processing unit, and a transponder which is mounted on the side or bottom of the car.

In designing the system, Siemens had to meet certain requirements specified by the International Union of Railways (UIC). The more important requirements were:

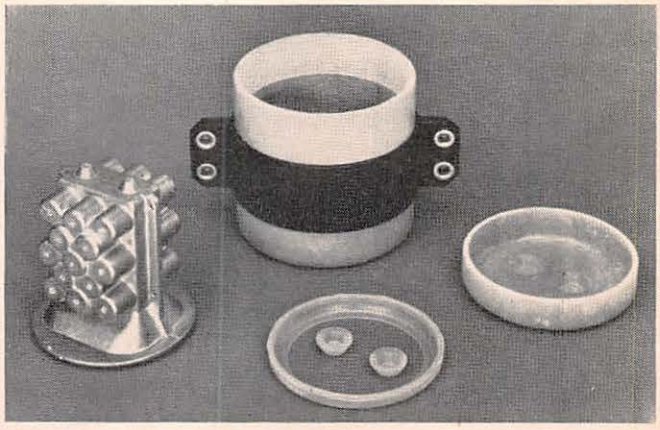
1. That equipment should operate satisfactorily under the rough conditions commonly found in railroad operations (temperatures between −58 to 167 degrees F, ice, smoke, fog, dirt).
2. That equipment and in particular the parts to be mounted on the car should be insensitive to shock and vibration and shall not require maintenance or power supplies.
3. That equipment should operate satisfactorily with train speeds of up to 125 mph.
4. That satisfactory operation of equipment should not suffer from external interference.
5. That car number reading be reliable and repeatable during any interference.

In the SICARID system a microwave signal is transmitted from the interrogator to the car-mounted transponder. The transponder is a passive unit comprised of tunable resonators, or cavities, whose special frequency-reflecting properties represent the coded number. According to Siemens, microwave energy transfer is only slightly affected by dirt, smoke, snow and ice. Upon receiving the microwave signal, the transponder reflects back a modulated signal to the receive portion of the interrogator. This signal is transferred to a processor where the number is read and forwarded to a central computer or data terminal.

The Siemens system operates in a



A flat version of the transponder is designed for mounting on the side of a car or on containers.



The cylindrical transponder, for mounting under a car, is housed in a fiberglass reinforced plastic case.

frequency range from 3.1 to 4.2 GHz. This band-width is swept in a period of 250 microseconds. This scan rate allows the system to operate with train speeds of up to 250 mph. This mode of operation offers the advantage of a completely passive transponder without any lumped elements, yet it allows a low transmitting power level of about 0.1 mW. For 13-digit car numbers, the frequency band is subdivided into 65 subbands of which five are assigned to each digit. At the frequency to which a resonator is tuned, the arriving energy is absorbed by the car unit because the resonators act as series-resonant circuits. Two of the five subbands are assigned resonators so that the digit is coded in a two-out-of-five code. The two-out-of-five code represents the numbers 0 to 9. Thus a car unit for a 13-digit number contains 13 times two = 26 resonators. The receive signal reflected and taken in by the receiver shows, during each frequency deviation, 26 absorption lines as information impulses, or energy drops, which are produced by the 26 resonators. These absorption lines represent the 13-digit identification numbers.

Depending on the speed of the passing train, the interrogator will scan the transponder a number of times to verify the correct code (e.g. approximately 40 scans at 125 mph).

Siemens use of the two-out-of-five code along with multiple scans of each transponder results in a very high degree of reading accuracy.

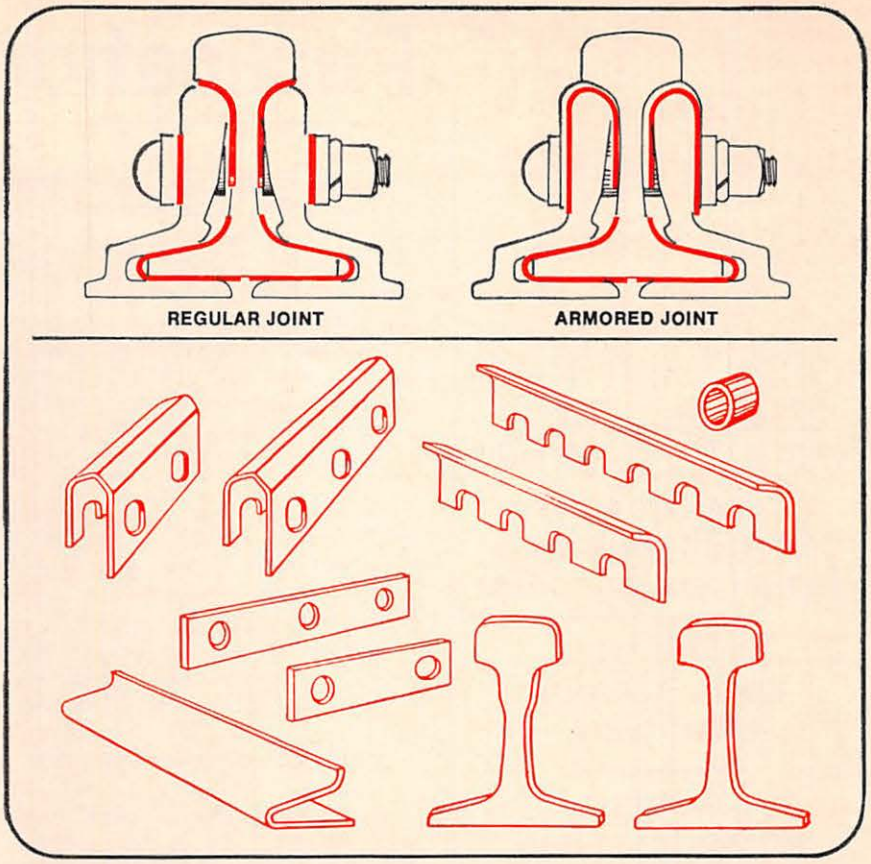
Car Unit

Siemens has designed two basic versions of microwave transponders. The original cylindrical design is made of stable aluminum casting and is housed in a sturdy fiberglass reinforced plastic case. The aluminum casting forms a horn type antenna running into a short-circuited waveguide with an array of 26 tuned cavities coupled to it. During operation, the microwave signal enters the waveguide through the antenna. When the frequency of the microwave is identical with the resonant frequency of a resonator, the microwave energy enters the resonator and is absorbed. If a frequency is not assigned a resonator the wave is reflected at the shorting plane of the waveguide. The cylindrical version was provided for mounting under the car.

The second version of transponders is a flat device especially designed for mounting on the side of a car or on containers, but it can also be mounted under the car. The flat and cylindrical versions have identical electronic characteristics.

According to Siemens, the cost of equipping a car with a transponder will be close to that of existing systems.

(continued on page 30)



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Publications

General Cable Corp. has announced the availability of a new publication titled, "Terminating Instructions—Mineral Insulated Cables." The brochure shows the steps involved in terminating the cable for hazardous or non-hazardous conditions and provides tips on training, bending, splicing, fastening and supporting the self-contained wiring system. *General Cable Corp.*

Circle 101 on reader service card

Globe-Union, Inc. has announced new literature for its 14-volt GP-1426 communications battery pack and 14-volt GC-1400 rechargeable battery pack. Both catalog sheets provide capsule descriptions of the features, operational instructions and typical uses. *Globe Battery Division, Globe-Union, Inc.*

Circle 102 on reader service card

A comprehensive 28-page booklet covering the 11A Common-Channel Signaling System is available from GTE Lenkurt Inc. Providing a unique type of signaling facilities for carrier and multiplex circuits, the 11A is said to offer a low-cost alternative to conventional in-band, single-frequency signaling. The equipment functions by converting the signaling information of up to 24 telephone circuits into a 2400 b/s data stream that is assigned to one common voice channel. Immune to talk-down or talk-off, the 11A is also said to reduce loading, thus improving the overall performance of radio transmission facilities. *GTE Lenkurt Inc.*

Circle 103 on reader service card

Now available from the Gulton Measurement & Control Systems Division is a 24-page condensed catalog providing basic technical details on their complete line of testing, measuring, monitoring and control instruments. Brief specifications are provided for portable multichannel oscillographic recorders, lightweight portable recorders, OEM building blocks, event recorders, miniature recorders, non-impact thermal line printers, servo recorders, portable potentiometers, temperature controllers, final control devices, thermocouples, resistance bulbs, and eddy current fastener hole flaw detection systems. *Measurement & Control Systems Division, Gulton Industries, Inc.*

Circle 104 on reader service card

Newly developed electrical testing instruments and systems for a wide variety of applications in laboratories, shops and in the field in many different industries take their place beside regular Biddle products as illustrated and described in a multi-color, 16-page bulletin recently issued by the James G. Biddle Co. New insulation testers, a new ac high-pot tester, and new models of cable fault locating equipment are among the additions illustrated and described, together with Biddle's transformer turn ratio test sets, earth testers, low resistance ohmmeters, bridges, dielectric test sets, corona measuring systems, precision potentiometers and motor testers. *James G. Biddle Co.*

Circle 105 on reader service card

International Data Sciences, Inc. of Providence, R.I., is offering a catalog of data communications products. The catalog describes data communication test sets for low and medium speed asynchronous modems, medium and high speed synchronous modems, Bell 300 series or equivalent wideband modems, time division multiplexers and frequency division multiplexers. *International Data Sciences, Inc.*

Circle 106 on reader service card

A 4-page brochure and two specification sheets describe AzurData's new hand-held source data automation terminals. Available in two configurations, both are completely self-contained, battery powered, and weigh 2½ lbs. They are taken wherever a man can walk, climb or drive, to the sources of information and collect the data. Then, the data stored in memory can be sent from the terminals in ASCII or other standard codes, through a small auxiliary transmitter and over a telephone line, directly to a computer center for processing. The Infopac I unit offers a solid-state memory with a capacity of up to 16,384 characters, and data is entered by use of the built-in keyboard. The Infopac II has a capacity of 30,720 characters. *Azur Data, Inc.*

Circle 107 on reader service card

A technical product sheet is now available on Globe Battery Division's Gel/Cell GC 620-1 (1.8 A.H.) rechargeable battery. A sealed, no-maintenance gelled electrolyte design, it is recommended for applications requiring maximum recharge cycles and short recharge time, as well as for standby power such as alarm systems and emergency lighting applications where long life is important. *Globe Battery Division, Globe-Union Inc.*

Circle 108 on reader service card

Microwave vehicle identification system developed for U.S. Army

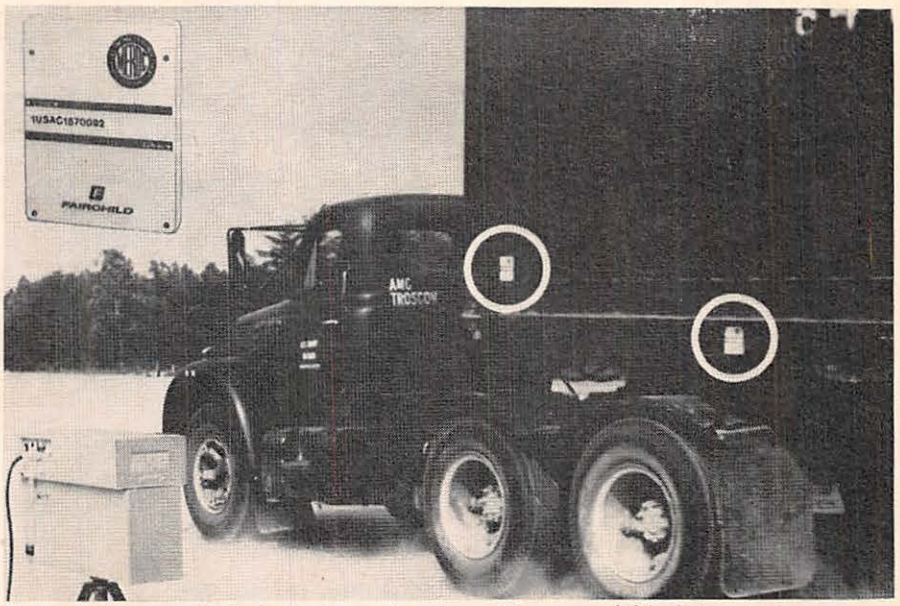
Finding an accurate means of automatic vehicle identification has been a problem for other areas of the transportation industry as well as the railroads. Electronic identification of large shipping containers, trucks, buses and other vehicles by serial number or license number could greatly reduce operating costs for many current operations. Even the U.S. Army has expressed a need for some type of automatic identification system to be applied to its containers and truck fleet. In response to this need, the U.S. Army Mobility Equipment Research and Development Center is currently testing a microwave vehicle identification system which was developed by Fairchild Space and Electronics Co. The Army's contract calls for systems engineering, design and fabrication of a "brassboard" model Container Reporting and Supply Management System.

The new system will automatically identify and record the location of containers used to transport a high percentage of all commercial and military goods and equipment. The same system, according to Fairchild, can be used for railroad cars, piggyback trailers, and automobiles.

Utilizing a label attached to the side of the container, an automatic electronic interrogator, small enough to be handled by one man, will read the serial number on each container which passes through its field. The interrogator will read the labels at distances up to 20 ft. and at speeds as high as 85 mph.

The data gathered by the interrogators will be transmitted to a central control terminal as the container passes designated points along highway, rail or sea routes.

The electronic labels measure four by five inches. Present development labels are ¾ in. thick but design effort has begun to reduce the production label to ¼ in. thick. The label is fully solid-state and contains no internal power source. Operational power is obtained from the interrogators' radiation. During operation, a low level, 2.5 GHz microwave signal is continuously scanning the passing vehicles. The energy radiated from the interrogator stimulates the circuitry within the passing label, and in turn the label uses this power to send back a signal indicating that it has received the basic frequency. Next, the interrogator steps-up its power output to a sufficient level to drive the digital logic circuitry in the label.



Two labels, mounted six feet apart, are read by a roadside interrogator.

Using this power, the label sends an amplitude modulated code indicating which number the label is representing.

The initial stimulation, plus first scan, takes about three milliseconds. The interrogator is programmed to read each label three times, which takes a total of eight milliseconds.

The present label is capable of transmitting up to 16 decimal digits. Using the binary system for representing each digit, 64 binary digits of data are actually transmitted—four for each digit. Alphabet characters are each identified by two numbers.

Cost of each label should be around $10 or $15 for large scale production.

A major requirement for the system is its detection and reading of labels under a wide range of environmental conditions yet maintain a high degree of accuracy. According to Fairchild, the label is virtually immune to any normal dirt or ice accumulation.

The portable interrogator is capable of reading multiple electronic labels separated by at least six feet. Thus, one label can identify the container and its contents while another label, affixed to the carrier, can tell the identity of the truck, railroad car or other vehicle transporting the shipment. The wayside interrogator has all necessary equipment for transmission built right into one portable chassis. Data output requires a voice-grade link at 2400 baud to transmit the data in real time. The interrogator can be mounted on any conventional frame or rack. The only alignment requirement is to maintain directional limits within a 30 degree skew angle in all three axes.

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OPERATIONS & SIGNALING BASICS ARE AGAIN AVAILABLE

RAILROAD OPERATION AND RAILWAY SIGNALING: The basic text which explains the relationship between train operation and railway signaling is now available in reprint form. The text is in the form of questions and answers so that the reader may know the objective of the information given, and to place emphasis upon the "why" and "how" of railway signaling and railroad operation.

Topics covered include fixed signals, block signaling, interlockings, centralized traffic control, cab signals and highway grade crossing protection. This is a reprint of the 1953 edition of RAILROAD OPERATION AND RAILWAY SIGNALING by Edmund J. Phillips, Jr., Simmons-Boardman Publishing Corp., 350 Broadway, New York, N.Y. 10013. Softbound. Price: 1 to 9 copies at $5.95 each; 10 or more copies at $5.00 each. To obtain copies, please fill out the coupon and send check or money order along with your order.

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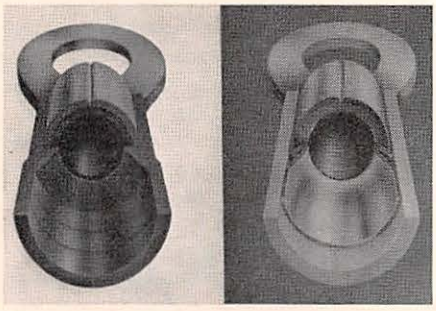
Product News

Portable safety light is rechargeable

A new portable safety light featuring a 15,000 beam candlepower headlight is rechargeable. The portable light also features a glowing red tail light and can supply a 12-hour nonfading beam per charge. The headlight has a bulb with twin filaments for greater safety. It has an adjustable focus for use as a spot or flood light. An adjustable stand permits the light to rotate 170 degrees in a vertical plane. *Koehler Manufacturing Co.*

Circle 109 on reader service card



Solderless terminals are funnel-barrelled

A new line of funnel-barrelled solderless terminals include the latest design improvements in solderless terminals. The funnel-shaped terminal entry is said to minimize strand turnback and increase crimping speed and reliability. The terminals are offered in a variety of ring styles: Fixed Insulation Terminal (FIT), Fixed Insulation Insulation Grip (FIIG) and insulation restriction. The terminals are also available in male/female slip-on styles. The new line of funnel-entry terminals accepts wire sizes from 26 to 10 AWG and are available loose for manual crimping or on tape for use in the manufacturer's automatic crimping machine. *Hollingsworth Solderless Terminal Co.*

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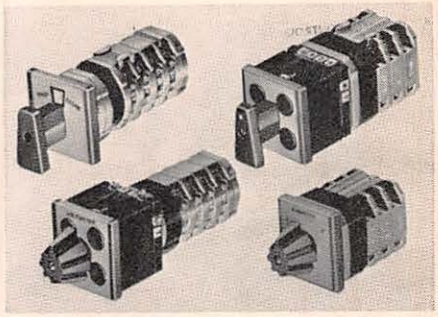

Instrument and control switches are miniaturized

To meet the need for reducing the size of master control panels and switchboards, a new line of heavy-duty, miniaturized instrument and control switches have been developed. The new switches are available in two basic capacities: 10 amp and 20 amp. Both lines are U.L. listed and are designed to mount on 3 in. centers for as much as a 50% reduction over standard switches. The user can incorporate optional feedback indicator lights directly on the nameplate itself for even more space savings. Standard available features include: central mechanical targets, spring-return, pull-to-lock, slip contacting, removeable handles, multi-contacts and others. The targets are of a new design which the manufacturer claims is virtually foolproof in operation, and they feature bright fluorescent colors for high visibility. *Electro Switch Corp.*

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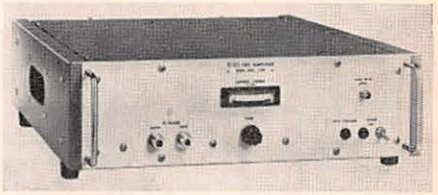

Microwave amplifiers give 1 watt/30 dB gain

Four TWT microwave amplifiers covering the range of 1 to 12.4 GHz provide 30 db minimum gain with 1

watt minimum output. Frequency ranges of the model 560A series are: 1–2, 2–4, 4–8, and 7–12.4 GHz. TWT control electrode is dc-coupled to a front panel BNC connector. Gain may be continuously controlled over a 50 dB range by means of an external 0–10 volt signal. Wide-band, complex RF signals and RF pulses with nanosecond rise time are reproduced when amplified within the linear gain region. Gain variation is less than 0.2 dB for line voltage variation from 105 to 125 volts. *Singer Instrumentation.*

Circle 112 on reader service card

Fault finder scope has a digital readout

A new fault-finding scope with digital readout of the distance to the cable fault is now available. The Model 1455 Cable Ranger scope uses the reflective radar principle to detect open or grounded faults in primary power cable, some secondary power cable, CATV and coaxial cable from 0 to 20,000 feet in length.

Thumb operated digital readout switches superimpose range steps over fault deflections displayed on a 5 in. CRT screen. When range steps are aligned with fault deflections, the numbers showing on the switch indicate, in feet, the distance from the end of the cable to the fault with a high degree of accuracy. *Radar Engineers Division of EPIC Corp.*

Circle 113 on reader service card

People

BURLINGTON NORTHERN.—**J. E. Kircher** appointed supervisor communications, Chicago; **L. A. Parker,** supervisor signals, Minneapolis; and **R. F. Reidelbach,** supervisor signals, Havre, Mont.

Other recent appointments: **J. H. Hedman,** supervisor signals, Superior, Wis.; **T. J. Hogg,** CTC engineer, signal engineering, St. Paul; **B. A. Ricketts,** general supervisor signals, Lincoln, Neb.; **D. H. Will,** manager, signal shop, engineering, St. Paul.

SANTA FE.—**Orrin C. French,** superintendent of signals-system, Chicago, retired March 1.

SOUTHERN.—**George L. Bell,** maintainer, appointed supervisor, communications and signals, Macon, Ga.

SUPPLIERS

John K. Ford, director-corporate computer services, **Rohr Industries, Inc.,** has been promoted to vice president-management systems and controls, succeeding **Thomas J. Bernard,** appointed vice president and general manager, **Flxible Co.,** Rohr's Ohio-based bus manufacturing subsidiary. Mr. Bernard succeeds **Joseph N. Kemple,** resigned.

Fred W. Garry, president of Rohr, recently announced a reorganization of the ground transportation activities. The Rail Division under **Raymond A. Raffensberger,** vice president, and the Flxible Co., under Mr. Bernard, will report directly to Mr. Garry. The Advanced Transportation Systems Division under **Walter J. Hesse,** vice president, will report to **Keith W. Tantlinger** senior vice president, New Product development. The groups previously had reported to a group vice president, Transportation Systems. The reorganization followed the resignation from that position of **N. John Beck,** who has left the company to pursue other business interests.

Howard J. Robbins has been appointed vice president, international marketing, **Rohr International Corp.,** a subsidiary of **Rohr Industries, Inc.,** Chula Vista, Calif. Robbins will direct the development of new international markets with special emphasis on ground transportation systems, including personal rapid transit and rail transit systems. Prior to joining Rohr, Robbins was executive vice president of GETECA, a consortium of 14 French aircraft equipment manufacturers that specializes in the sale of French technology to major American aircraft manufacturers.

Michael J. Dougherty has joined the **Bimetallics Division, Copperweld Corp.** as manager of industrial marketing, Glassport, Pa.

Loren L. Raglin, manufacturing manager, **Granger Associates,** Menlo Park, Calif., has been elected vice president of the company.

Roger C. Agnelly has been appointed manager-Pittsburgh district, **Okonite Co.** He was formerly sales representative-Milwaukee district.

John W. Bowman, Jr., has been appointed branch manager of a new sales and service facility of **C&D Batteries** at 10606 Hempstead Highway, Houston, Tex. Mr. Bowman succeeds **Martin G. Jogeese,** retired.

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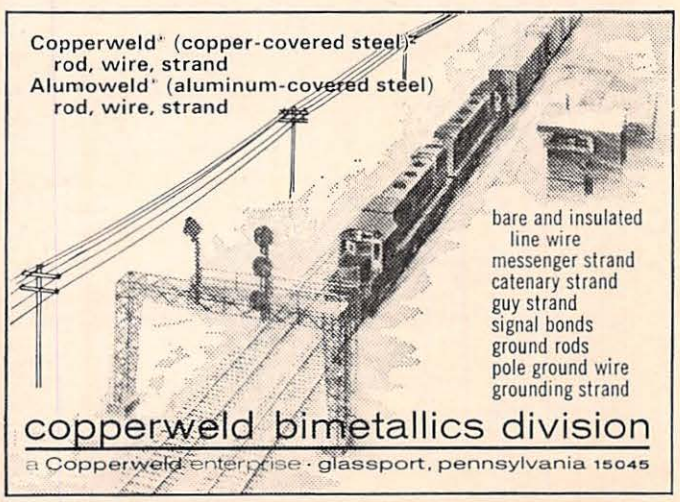

copperweld bimetallics division
a Copperweld enterprise · glassport, pennsylvania 15045

Circle 10 on Reader Service Card.

Microwave

(continued from page 25)

Wayside equipment

The interrogation equipment consists of a reader and a processor. The reader includes the antennas needed for transmission and reception. The front end of the receiver has a low noise baseband preamplifier. All modules including the antenna are built into an aluminum casting. The reader can be located beside the track for side mounted transponders, or it can be mounted between the ties for transponders mounted beneath the car. According to Siemens, the transponder-to-reader distances can range from 8 in. to 6½ ft. UIC test results indicate the prototype of a flat transponder can be read up to 10½ ft. and the cylindrical unit up to 15 ft. The transmit portion of the reader scans the 3.1 to 4.2 GHz band. The coded signal which is reflected back by the passing transponder is received by the reader and passed on to the processor.

The processor contains the solid-state microwave generator as well as the digital logic which processes the pulses arriving from the transponder unit via the reader. The incoming pulses are put into a shift register and, at the end of each scan, the whole car number is contained in the shift register in a two-out-of-five code. Since more than one scan is made, the number read in one scan can be compared with the read during the preceding scan. The checked number is then entered into a storage section of the processor. The storage is large enough to hold the numbers of more than 120 freight cars. The output of the storage section is transmitted over data lines to teleprinters or data processing equipment.

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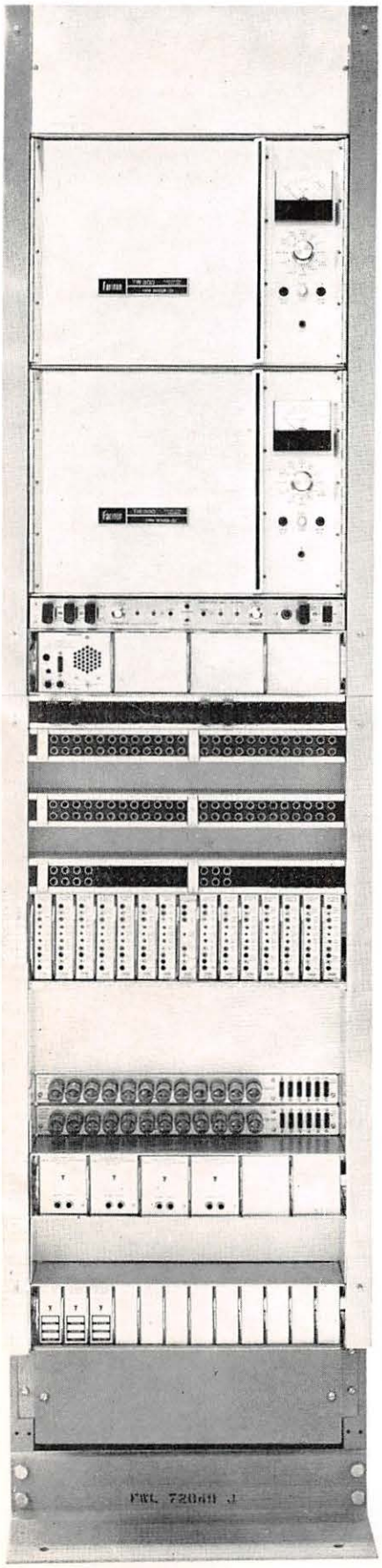

Terminal: transmitter, receiver, baseband equipment

Terminal: transmitter, receiver, baseband equipment

Protection shelf

Orderwire shelf

Jackfields, space for two more

12 multiplexed voice channels

Space for 12 more voice channels

Ballast lamps and fuses

E&M loop dial converters

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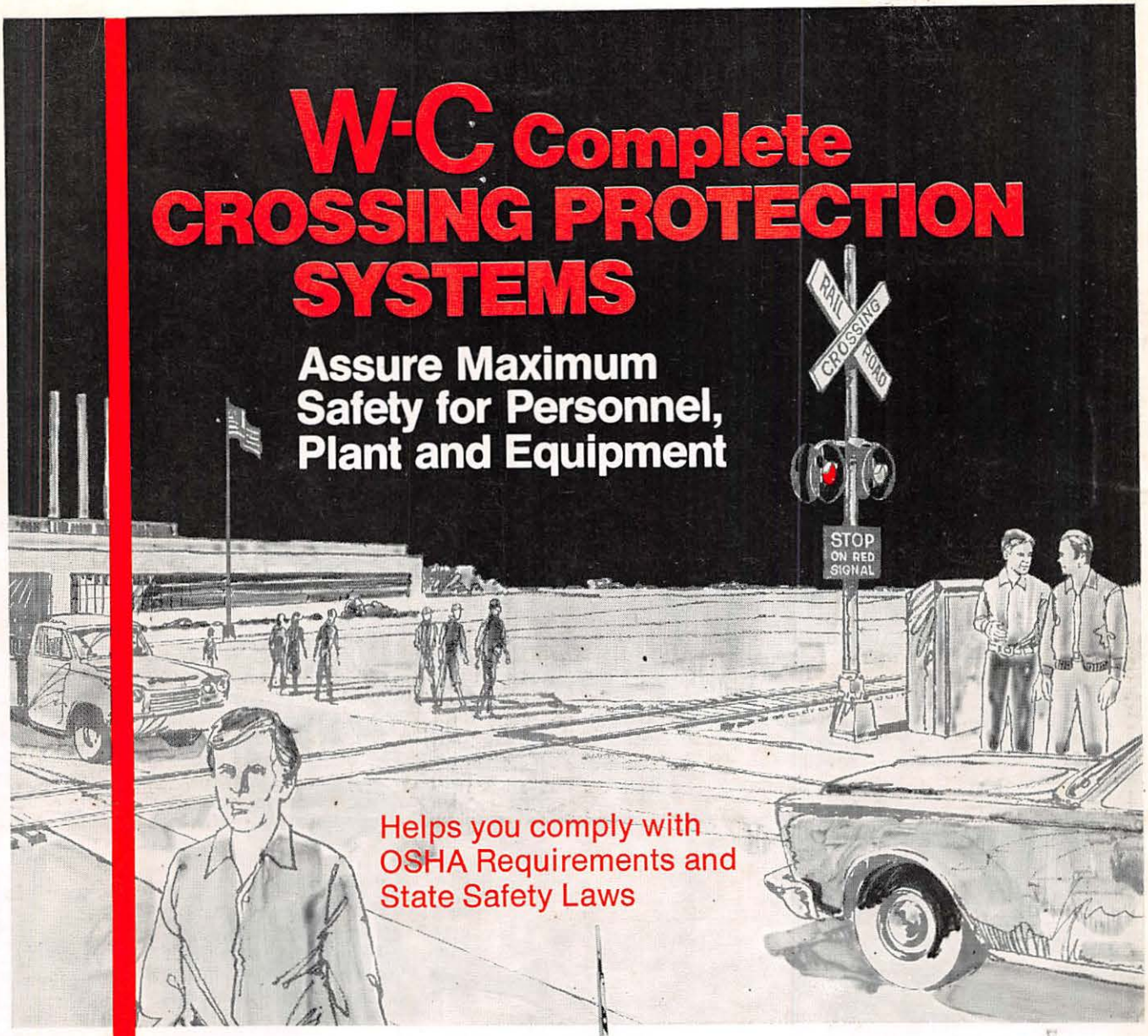

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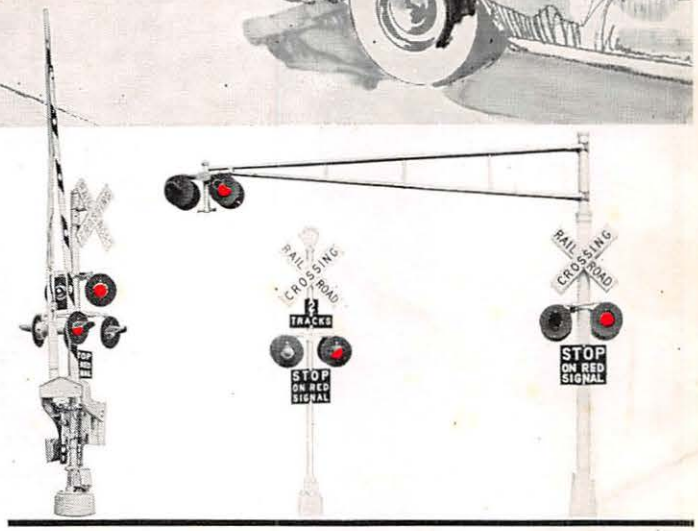

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